Editorial

THE Annual Federal Convention of the Wireless Institute of Australia was held in Sydney during Easter.

This convention is attended by representatives of the Institute's Divisions in every State, and decides major items of policy to be carried out in the forthcoming year.

Among the items passed was a direction to the Executive to seek from the PMG's Department two new types of amateur transmitting licence, to be known as the Novice licence and the Technician licence.

A Novice licence would be granted to those who passed a test in elementary radio theory, in regulations, and in Morse Code at the slow speed of 5 words per minute.

This licence would be current for one year, by which time the holder must have passed the normal Amateur examination to remain on the air. Only certain frequencies would be available to Novices.

The Technician licence would be granted to well qualified men who can pass the amateur examination with high marks, and will allow operation on VHF bands without a Morse Code test.

Should the PMG agree to issuing these licences, Amateur Radio will receive its biggest lift for years. To obtain full value from the Amateur bands, they must be made available to as many people as can lay claim to them. These two licences will extend the field at both ends.

The Novice licence will provide a training ground for the newcomer, and allow him practical experience. Too many keen converts lose interest before attaining the necessary code speed required at present, and are lost forever to Amateur ranks. They will learn more quickly and effectively, and their enthusiasm will be maintained, if they taste some results of their labors.

The Technician licence should bring many well-informed men into Amateur ranks who have neither time nor inclination to become proficient Code operators if their experimental work will not use it. Their position is acute today because of the widening scope of amateur technique. Such men should no longer be barred from active work "on the air."

The issue of these new licences would do a great deal to widen amateur viewpoint and enlarge its sphere of influence. The Institute is working on big plans for Civil Defence and Emergency work which will impose a still greater strain on its numbers. The more keen men we have with experience in all aspects of the radio art, the better will the Amateurs be able to support such plans.

Amateurs can play a big part in national service, and the more there are, the better their work will be done.

This magazine wholeheartedly endorses the new licence idea, and sincerely hopes the PMG will do likewise.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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OUR COVER PICTURE

One of two parabolic antennas, spaced several miles apart and sighted on one another by theodolite or telescope. Microwave links like this are often more portable and convenient than line equipment.

RIVAL TO THE GIANT CYCLOTRON

The massive cyclotron has a slender, atom-smashing rival. Known as an "electron linear accelerator," it was contructed at Stamford under a contract with the Office of Naval Research. Dr. William W. Hansen, Director of the Stamford Microwave Laboratory, reported that a 3ft section of the electro accelerator has produced electrons of more than a million and a half volts. He predicted that a projected larger model—100-200 feet long—would develop billion-volt electrons, which would be the highest charge of electricity ever produced by man. In contrast to the cyclotron, which accelerates the heavy positive-charged particles of an atom, the Stamford-built unit concentrates its power on the electron, the light, negatively-charged outer particle of the atom.

The ANARE Station at Atlas Coce, Heard Island. The high angle and clear air give the station the appearance of a tiny model. (ANARE photo.)

storms, could be one of the world's wealthiest areas; it could, quite easily, be one of the poorest.

Unlike the northern polar regions with its barren stretches of frozen water, most of Antarctica is an ice-covered plateau 10,000 feet above sea level.

Coal has been discovered there. This is proof that at one time there must have been vegetation and possibly life. Scientists are naturally optimistic it might even be rich in minerals.

THREE OUTPOSTS

Five years ago, the Australian National Antarctic Research Expedition was planned to set up three research stations, two on the Empire outposts at Heard and Macquarie Islands and the third on the Antarctic continent.

From the two island stations, now in the fifth year of operation, extensive meterological, biological and physical research has been conducted. A few of the party, each time, has taken with them a small transmitter and maintained contact with the world through the 20 and 40 metre amateur bands.

NEW MISSION TO ANTARCTICA

Only one great land mass yet remains to be explored — the great southern continent of Antarctica. It may be a barren waste or it may be an invaluable source of minerals, a great natural refrigerator and the key to long-range weather forecasting. A new expedition, now in the planning stage, proposes to solve some of these vexed questions.

by Roth Jones

GONE are the days when trips to Antarctica and the neighboring oceans were to establish whale fishing industries. Today this area offers almost unlimited scope to the scientist, the surveyor, the physicist and the biologist. In fact, every branch of the sciences can find more than enough to keep them busy and happy in the great white south.

Probably by the end of next year Australia will have established its first permanent base in its sector of Antarctica, the strange, mysterious continent with its roaring gales and blinding snowstorms.

In Melbourne, the Australian National Antarctic Research Expedition is planning to send a scientific and exploration party to the last great continent. This expedition will be more thorough than anything yet previously attempted south of the 60th parallel and members of the party will be making history.

OTHER EXPLORERS

They will follow closely on the footsteps of many other great Australian scientists - come - explorers: men like Sir Douglas Mawson, Captain J. K. Davis, John Rymill and Sir Hubert Wilkins.

Australia's sector of the southern continent extends eastward from a point south of Madagasgar to another south of Macquarie Island and inland to the South Pole with the exception of Adelie Land, a narrow strip of French territory.

This white continent, with its roaring gales and blinding snow-

P. G. (Phil) Law, leader of the expedition, has designed a 2400-ton ship especially for Antarctic exploration purposes ships previously used have been inadequate. (ANARE photo.)

Their VK1 call signs have been heard regularly in recent years and a bond of friendship between the Wireless Institute of Australia and the antarctic explorers is now thriving.

Both islands play a far greater role in Australia's life today than most people realise. They send weather reports to Australia every six hours. Biologists' study of the elephant seal may one day lead to the marketing of its oil, while the physicists' observations into cosmic rays, radio-physics, geomagnetism and seismology are proving valuable to scientists everywhere.

SHIP NEEDED

Lack of a suitable ship, however, has so far prevented a postwar Australian expedition to the Antarctic continent.

A 2400 ton expedition ship has been designed by the expedition leader Mr. P. G. Law and he hopes construction will commence this year. When built, this ship, the most modern of its kind afloat, will take a party of explorers through the "roaring forties" to their new base

Already huskies are being bred at Heard Island for the expedition and two Auster aircraft, which can land either on sea or pack ice, have been purchased by the Australian Government as reconnaissance aircraft.

Light, easily manoeuvrable, these aircraft have a 150-mile range. They greatly assisted the Norwegian-British-Swedish expedition reaching

the Norwegian sector of the continent in 1950.

Phil Law, as the leader is known to all the antarctic explorers and scientists, like most of his colleagues in the scientific world, looks to the future. He is not a dreamer but a practical scientist and is Australia's greatest authority on the antarctic. He sees in Antarctica a land of inestimble value in time of peace and war, whose waters are rich in sea food.

Just before he left Melbourne late in March to assist in the relief of the Macquarie Island party he summed up Antarctica's future this way:

POSSIBILITIES

SEA FOOD. Plankton, the highly nutritive sea food, which helped feed the Kon-Tiki crew during their expedition in the Pacific, abounds in Antarctic waters. Biologists have yet to determine whether this could be processed and tinned in sufficient quantity to relieve the world food shortage.

REFRIGERATOR. Surplus food frequently thrown away in times of glut could be transported to Antarctica and stored until required.

MINERAL RESOURCES. Uranium and other important minerals might be available in the continent. Using atomic energy to melt the ice, these minerals could, if discovered, be worked commercially.

METEOROLOGY. Weather reports from Heard and Macquarie Islands are now assisting Australian forecasters. A station in Antarctica, providing the third point in a huge triangle would ensure more accurate daily forecasts. Seasonal forecasts might prove possible as a result of these observations.

EXPLORATION. There is work for years to come mapping accurately the coastline and in exploring the inland. Large portions of the shore, clustered with pack-ice for most of the year, has never been accurately mapped.

IDEAL BASE

Australia is an ideal base from which to carry out this important work today. It is close by and the five years' work at Heard and Macquarie Islands have not been in vain. A group of young, enthusiastic highly trained men are longing for the chance to go farther south and the expedition has an efficient and experienced administrative organisation which can maintain the men in the south.

Present plans (and they seem unlikely to be altered) are for a permanent expedition to be relieved every year by the new ship.

In the past, expeditions to Antarctica have not been permanent. Often an old or chartered ship has proved quite inadequate.

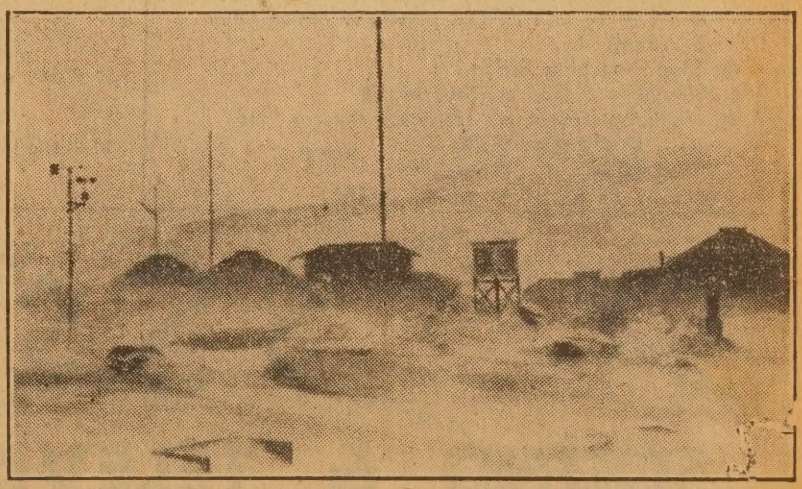
If a permanent group of stations is to be established, a specially designed vessel will have to be built for the dangerous tasks ahead.

That is why this ship, now on the drawing board, is so important. There will be no happier man in Australia than Phil Law when he sails south in his new ship to hoist the flag on Australia's sector of Antarctica. He could rightly be called one of Australia's great sons.

EQUIPMENT FOR HEARD ISLAND

Taken in 1948, this photograph shows a diesel generating set being unloaded at Heard Island. Weather reports are radioed to Australia every 6 hours. (ANARE photo.)

Expedition leader Phil. Law, photographed on Heard Island (ANARE photo).



Life in the Antarctic takes on a different aspect when the winds whip up the snow and sleet in a raging blizzard. (ANARE photo.)

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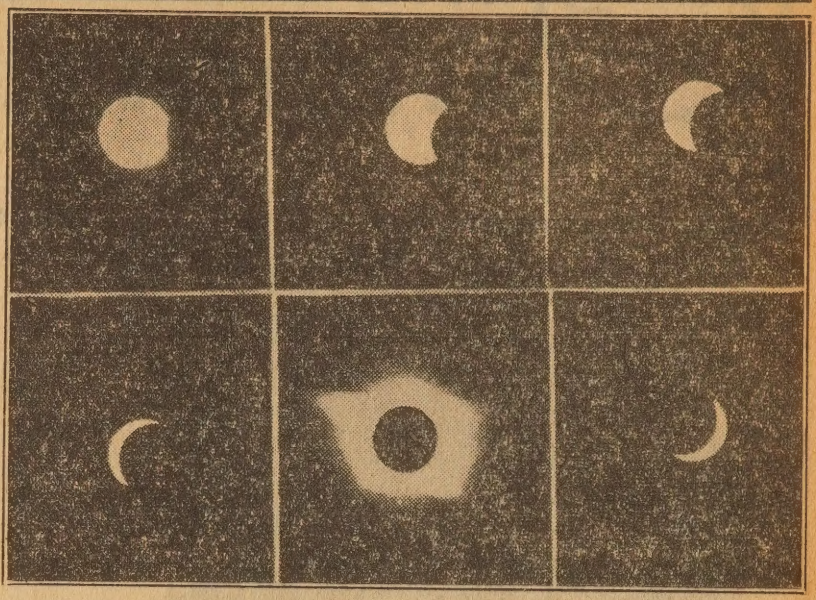

The moon slid in front of the sun for three minutes on Feb. 25, and threw a shadow 9000 miles long and 85 miles wide over the face of the earth. The six photos show successive phases of the eclipse.

On February 25 this year Londoners looked up and saw the sun through a dense layer of fog and murk. In the absence of the usual glare the sun looked like a gleaming silver coin, and from 8.41 am to 9.47 am it had a small dark "bite" out of its lower left-hand edge.

THIS was the eclipse that, 4000 miles away in the sacred Hindu village of Kurukshetra, was regarded as the greatest battle between the sun god and the demon Rahu for more than 1000 years. More than half a million pilgrims plunged themselves in Kurukshetra's seven holy lakes, blew conch shells and yelled prayers to ensure that the sun god would win.

GUARD OF SCOUTS

Three thousand Boy Scouts, controlled by Kurukshetra's mayor, who was mounted on an elephant, stood by to prevent casualties from drowning or trampling in the vast crowds. No one was hurt, the sun god won handsomely and everyone considered the eclipse had been a great success.

About 1000 miles west of Kurukshetra, in an abandoned Army camp three miles out of Khartoum in the Sudan, another group of "eclipse pilgrims" were just as excited. These were the 150 astronomers, radio-physicists, geographers, nuclear fission experts, meteorologists and pure mathematicians from the Western World who had brought £1,000,000 worth of equipment to record and analyse the moon's blotting out of the sun's rays at high noon.

From their 189-second observation these experts from 10 nations got enough data to keep them busy for at least two years. When they have worked out their new calculations they will prepare for the next total eclipse in 1955—and the box seat for this will be "somewhere in Indo-China."

This year the moon's 9000-mile long shadow fell over an 85-mile wide strip of the earth's surface from mid-Atlantic across Central Africa, from Libreville to Khartoum, and up through Basra on the Persian Gulf to central Siberia.

PERFECT LOCATION

The best position, the weather forecasters said (and they proved right), was near Kartoum where there was no cloud, perfect visibility —and even the breeze which vibrated the delicate electro-telescopes early in the day dropped completely while the eclipse ran its classic course, "the most momentous since 1868."

Professor Roderick Redman, leader of the Cambridge Observatory's team at Khartoum, says the conditions were ideal, but he cannot yet discuss his results. He was there to collect new data on the atomic activity and temperatures in the chromosphere, the sun's gaseous envelope.

It will take him 18 months to work out his calculations. By then he hopes to know whether the guesses about the heat radiated by the sun are correct. The latest estimate was that the chromosphere cooks away at more than 1,000,000 degrees Centigrade, but as far as Professor Redman is concerned that is just speculation.

Another problem the Cambridge team hope to solve is how matter behaves in the fierce solar laboratory where atoms are pushed about in a way earthbound scientists cannot hope to copy. Among the many unanswered questions, for example, is how is the sun's output of energy maintained? Scientists claim it cannot be by "burning" because the atoms in the sun's gases cannot be left with enough electrons to combine chemically as they do in normal combustion.

by ***Nigel Palethorpe***

From London

The prevailing theory is that the sun works rather like an atom-bomb —but by building up new atomic nuclei instead of destroying existing ones. It is thought hydrogen is transformed by a series of complex chain reactions into helium and the resultant loss of mass reappears as radiant energy. If scientists could discover how this is done in the sun they might be able to repeat the process in their laboratories—an advance that would mean ordinary, easily available, materials could be used for the production of atomic energy instead of the present rare and costly ones.

Professor Redman and his colleagues collected their new data by watching the flaming prominences (the huge tongues of burning gas around the sun) which can be observed only during an eclipse. But other observers were more interested in the corona.

STUDY OF CORONA

This is the huge, faintly luminous cloud that reaches as far as 1,000,000 miles from the sun and yet has temperatures much greater than those in the sun itself. How the corona is kept in this super-solar frenzy of heat is a complete mystery, but scientists know that atoms in the corona are far more highly ionised than the sun's particles and surge both away from and toward the sun as though the gravitational attraction of the sun were cut off.

Other English observers — a group from the Greenwich Laboratories — were mainly interested in a slightly angled view of the eclipse. They set up their observation post slightly outside the path of totality—the 85-mile-wide moon-shadow. These men photographed the movement of the slim crescent of the sun left visible by the moon so that they could check the exact relationship of the two bodies and relate their findings to the infinitesimal variations in time which,

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it is calculated, have caused the earth to rotate a little shower than it used to 2000 years ago.

How much slower? Three-hundredths of a second a day — which means modern man lives about 12½ minutes longer in his 70-year span than did the man of Biblical times. This sort of variation does not affect the average man noticeably, but the men who went to Khartoum to get new facts about the behavior of radio waves hope to have more practical results than the split-second watchers of Greenwich.

Britain's Radio Research Station team from Slough, in Buckinghamshire, wanted to check up on what happens to the ionosphere when the electrifying rays of the sun are blocked out from this shortwave sounding board. The ionosphere is always subject to various disturbing influences from the sun, especially solar flares — the sudden bursts of radiation that have some connection with sunspots. They cause magnetic storms, radio fade-outs and background noise in long-distance transmission.

MUCH DATA

The more we can discover about the relationship between the varying intensity of cosmic rays from the sun and the composition of the ionosphere the greater will be our chances of improving radio communication.

The Slough team made their measurements and observations with radar signals, radio-sonde balloons and aircraft. And their results, which will have to be correlated with the observations of other radio experts all along the 9000-mile track of the eclipse, will take many months to assemble and many more months to analyse.

These radio-astronomers, says Professor Redman, had more new equipment than any of the other experts, and their harvest of new information is expected to be greater and of more practical use than in any other scientific sphere.

The Americans observed this year's eclipse with more equipment and men than any other nation. Their Air Force personnel were spread right across Africa along the 3000-mile moon-shadow from Libreville to Khartoum. From their recording of light intensities during the eclipse with photo-electric cells they hope to improve the measurement of time and distance and correct the present maps of Africa to within 200ft of accuracy.

RARE ECLIPSE

The National Geographic Society of America sent its men to Khartoum to concentrate on photographing the stars near the sun which are visible only when the moon blocks out the solar light. They made a film of the eclipse to record the bending of light from the distant stars — data which will take at least two years to interpret from the photographic record. It will provide an invaluable check on Professor Albert Einstein's theory of relativity. (The 1918 eclipse demonstrated that Einstein's theory stood up to practical observation, but there is still much to be learned. This year's recording of the light behavior of stars was much more accurate than before.)

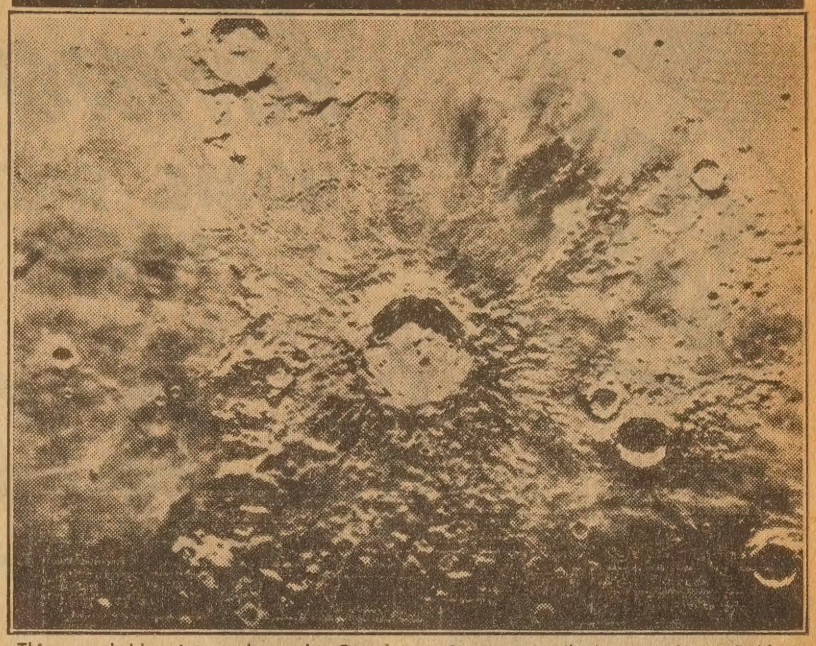
There is an eclipse almost every year, but it is seldom that it can be observed with accuracy. The angle of sight from the earth, the atmospheric conditions, the time of day —all these were perfect at Khartoum. It may not be as easy to see and record a total eclipse again until 1999 when the moon's shadow will fall across London.

Even at Khartoum there were two hazards that had the professors tossing sleeplessly in their beds for months before it happened — the one-in-ten chance of a sandstorm (which would have ruined all their plans), and the failure of Khartoum's municipal electricity supply (an almost 50-50 chance), which would have thrown nearly all the recording equipment out of action.

The scientists could do nothing about the sandstorm, but they did take the precaution of taking their own generating plant with them to the deserted Army campsite.

For once foresight and good luck combined and the 1952 eclipse was a brilliant success — just as it was for the 500,000 Hindu pilgrims to Kurukshetra, where the sun god overthrew the demon Rahu in exactly three minutes nine seconds.

CLOSE-UP OF MOON'S SURFACE



This remarkable picture shows the Copernicus Crater, 56 miles across. Since Galileo turned the first telescope on the moon in 1610, astronomers have counted 30,000 such craters. Some believe them to be extinct volcanoes. Others think they are the result of meteors striking the moon. The moon rotates but as the same side is always toward the earth, about two-fifths of the moon's surface has never been seen by earthly astronomers. The visible part shows no life.

MORE REALISM WITH NEW SCREEN

A NEW and radically different motion picture projection screen, hailed as the first major improvement in film projection in 25 years, has been placed on the market by the Radio Corporation of America. The first installation was made in the Plaza Theatre, New York.

Designed by theatre architect Ben Schlanger and his associate, William Hoffberg, the screen features side wings and a top panel which together pick up and reflect diffused light from the picture.

When color pictures are shown, reflected hues appear on the wings and panel. This effect gives a dramatic sense of realism by making the screen action appear to occupy a larger portion of the viewer's field of vision.

The screen is made by RCA Snowhite screen material, a heavyweight Firestone "Velon" plastic.

Because the projecting wings are not directly lighted, but pick up only the illumination from the screen, the intensity of light and the predominant color reflected by these panels vary in proportion to these same factors present in the screen picture.

The optical impression is that of viewing a "live" scene, where vision is concentrated on a particular object or in a certain direction, but the viewer is conscious of the surrounding area at which he is not looking directly.

The new screen allows for this peripheral vision, or "seeing out of the corner of the eye," in contrast to the sharp cut-off necessary in the conventional screen, which gives a picture which is sharply outlined.

The RCA wide-vision screen consists of the image screen on which the picture is actually projected, narrow (9in) flanges set at a relatively acute angle to the screen.

The picture image is actually "framed" on the screen by the flanges, which perform the same function as the usual black masking to eliminate fuzzy edges, but diffused light and color from the projected picture are picked up by the wings at sides and top of the screen.

Reflection of light on these wings eliminates the sharp, contracting outline of the screen image and makes it appear to taper off in the outer portions of the spectator's field of vision.

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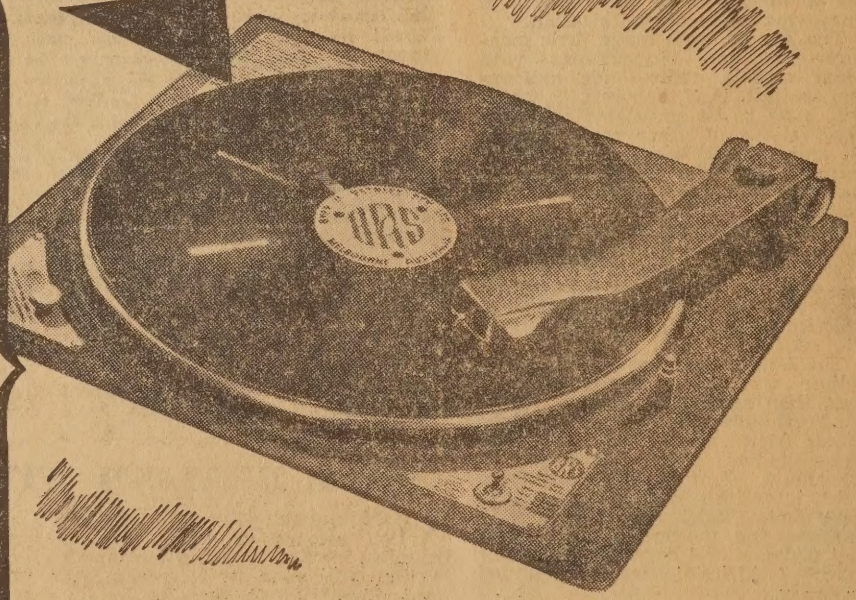

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BRITAIN'S LATEST IN HELICOPTERS

During the war years, British designers had largely to abandon work on helicopters, with the result that they were left well behind by America n manufacturers. With the helicopter now coming into its own, British designers are making an effort to catch up.

THIS is something of a paradox because it was in Britain that the Spaniard Senor Cierva had done all his great work, and had developed the "flapping blades" which made the true helicopter possible.

At first it was only possible to manufacture, under licence, existing United States designs such as the Sikorsky S.51 and later the S.55. This was a job taken on by the Westland Aircraft Company which made available a supply of practical helicopters on which civil and armed services operators could "graduate" in the rotating wing technique.

MAIL SERVICES

This was brilliantly done, especially by British European Airways and Britain's Royal Navy. B.E.A., with their Sikorskys, operated day and night mail services, and then moved on to regular passenger carrying schedules which are still a model of efficiency.

Night landing equipment; the Decca track (navigational) guide, and several other pieces of operational equipment were evolved which did much to restore to Britain the "lost" years of 1939-45.

As far as helicopters were concerned Britain, because of its small size, and the nearness of Continental Europe, was natural helicopter country. For B.E.A., therefore, the city centre to city centre machine was clearly the "aircraft of the future."

Equally, the Royal Navy, always concerned with the safe passage of merchant shipping to the United Kingdom, saw the anti-submarine potential of a machine which could hover over a given spot of ocean and which could be carried on the deck of any sizeable merchantman.

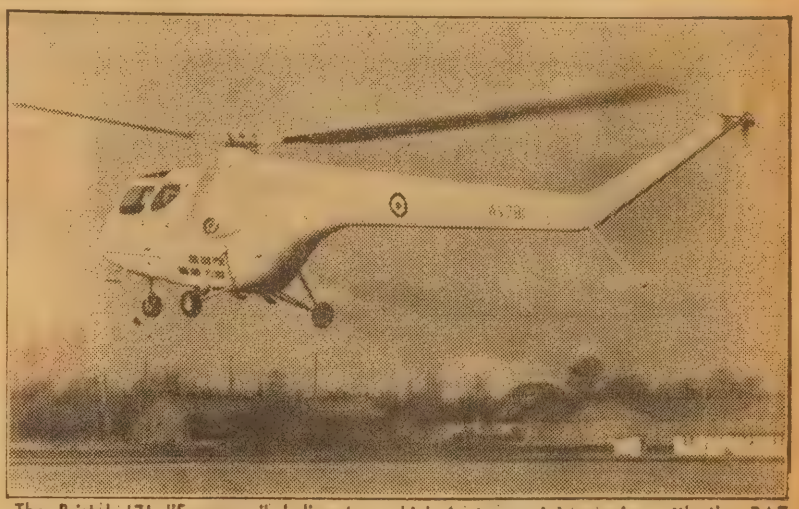
Experiments at sea were carried out, and as a first result, it is now a ruling that every aircraft carrier in the Royal Navy shall have its helicopter flight aboard.

Much of this was done with existing United States machines. But, parallel to this practical research, was a campaign for United Kingdom designed helicopters for a diversity of jobs. Three firms were commissioned to produce both military and civil designs.

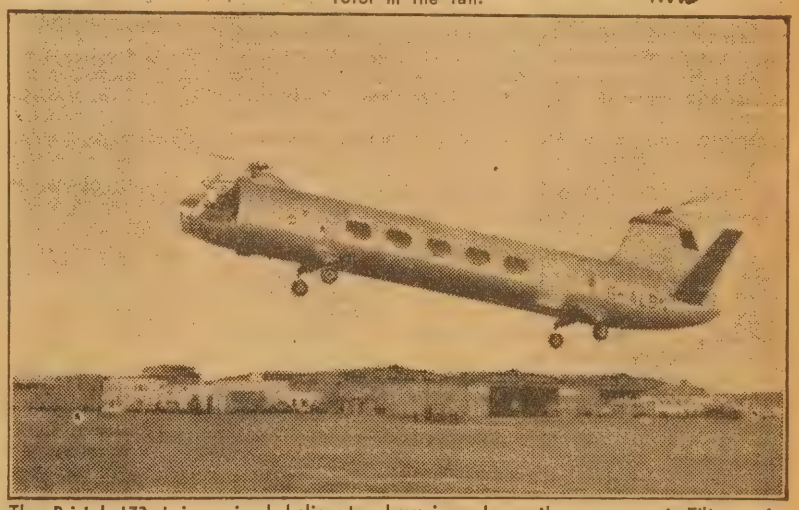
THE "GYRODYNE"

Messrs. Fairey produced the "Gyrodyne", a helicopter which also used the forward traction of an ordinary airscrew. It was this machine which in 1948 set up the helicopter speed record of 124 miles (198 kilometres) per hour. Unfortunately the Gyrodyne later crashed, but it was clearly a machine of great promise, and presumably is being followed up.

Meanwhile the firm of Cierva, named after the man who, in 1923, made the first successful flights with rotating wing aircraft, showed with its giant "Air Horse" the potentialities of weight lifting in future multi-rotor designs.



The Bristol 171 "Sycamore" helicopter, which is to go into service with the RAF Coastal Command. Seating 4 or 5 passengers, the Sycamore has a 550hp Alvis Leonides radial motor and uses conventional main rotor, with torque compensating rotor in the tail.



The Bristol 173 twin-engined helicopter hovering above the runway at Filtom airfield during the machine's maiden flight. Carrying 12 passengers and pilot, the 173 has an engine at each end of the fuselage, driving the two rotors, which operate in opposite directions. One engine can operate both rotors in the event of a failure.

The Air Horse and the Gyrodyne, however, were new and experimental and for an immediately practical helicopter, Britain turned to the great firm of Bristols, which produced the successful, though orthodox, "Sycamore," a fine single rotor helicopter which is now being used by B.E.A., the Royal Navy, and Royal Air Force and the Royal Australian Navy.

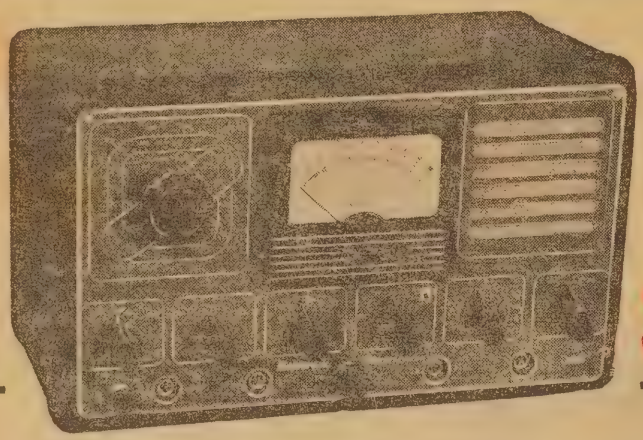
This aircraft gave Bristols the initial experience it needed to build the Bristol 173, a twin engined, twin rotor 13 seater which has already made its first flights. This machine, as advanced as any now flying, is starting off the real helicopter air age in Britain.

With two engined safety, permission can be given, for the first time, for direct regular services between built up areas. Hitherto, with only single engined machines, the risk has been too great. It will be a year or two yet before the Bristol 173's come into public use, but, when they do, they will link central London direct with many United Kindom cities, and up to a radius of 200 miles (320 kilometres) abroad.

By that time, bigger and faster 30 seaters should be in production, perhaps using gas turbine engines.

There is no doubt that Britain is going ahead on the helicopter — just as she has done on civil jets. The Sycamore and the 173 are but the start.

Modern Methods with a Modern Instrument . . .



The UNIVERSITY Model AST SUPERTRACER

To be real'y up-to-date, to be able to do service work speedily and accurately, you must have the right testing equipment, and the test unit which has all the requirements is the University AST Supertracer.

This is the most modern, up-to-date, and efficient service instrument that anyone could desire. It is easy to use and gives rapid and accurate location of faults in radio receivers and similar equipment. It speeds up testing, servicing, and production, and will rapidly detect faults which render a receiver inoperative, or which make it intermittent or lacking in sensitivity, or which cause oscillation, distortion or hum.

The instrument comprises a two-stage tuned R.F. amplifier, a diode detector, and two-stage A.F. Amplifier and, of course, a loudspeaker and power supply. In addition, a vacuum tube voltmeter measuring up to 500 volts A.C. or D.C. at a resistance of 11 megohms on D.C. and 10 megohms on A.C is provided. The tuning range of the R.F. circuits is 175 to 490 K.C., 550 to 1550 K.C., 1.5 to 4 megacycles, and 6.3 to 18 megacycles R.F. sensitivity is such that input voltage of the order of a few millivolts may be detected on all ranges, so that the instrument is suitable for use in any district where alternating power mains are available. A capacity type R.F. multiplier in the input circuits in conjunction with the V.T.V.M. enables stage gain measurements to be made.

TEST PROBES: The R.F. test probe is fitted internally with a very small series capacity of a few micro-microfarads, so that it does not produce an appreciate detuning effect when applied to the grid or plate of R.F. or I.F. stages in a receiver. The A.F. test probe is a conventional shielded lead for feeding A.F. into the tracer or A.F. out from the tracer for testing A.F. amplifiers or speakers. The D.C. probe contains a series 1 meg isolating resistor, so that the V.T.V.M. may be used to measure plate bias or A.V.C. voltage under actual operating conditions without disturbing the action of a receiver.

VACUUM TUBE VOLTMETER: The V.T.V.M. features a centre zero scale for direct voltage measurement, so that voltages which are either positive or negative with respect to a receiver's chassis are instantly indicated without the necessity of reversing test leads or operating a reversing switch. Zero is at the left for alternating voltage ranges, and operation covers the audio frequency range. Voltage ranges are 0/5, 0/25, 0/100, and 0/500 volts at an input resistance of 11 megohms on D.C. and 10 megohms on A.C. ranges. In conjunction with the amplifying stages of the tracer, the meter will indicate R.F. or A.F. voltages down to a value less than 1 millivolt. Indications are provided by a large, clearly marked rectangular meter with illuminated scale fitted in an attractive modern plastic case measuring 4¾" x 4". The V.T.V.M. and tracer may be used simultaneously for observing signals at two distinct points in a receiver. This feature greatly facilitates location of intermittent faults. Operates from A.C. 220 to 260 Volts.

ILLUSTRATIVE LITERATURE AVAILABLE ON REQUEST.

RADIO & ELECTRONIC TEST EQUIPMENT

University

Made by University Graham Instrument Co.,

5 NORTH YORK STREET, SYDNEY. 'Phone BU3169 (2 lines)

LOOKING FOR ART IN ALGEBRA

Professor Baravalla's light figures add a perplexing touch to this portrait of himself. The spiral shadows lend a weird air of ancient magic to an otherwise ordinary photograph.

Typical solids. Tower in foreground is composed of "three basic conic curves, hyperbolas, a parabola which closes into elipses and elipses which rise into infinity."

To most people, mathematics is a prosaic, matter-of-fact subject, involving angular diagrams and masses of uninteresting figures. In actual fact, however, the curves and shapes which result from plotting graphically many formulas are attractive in the extreme.

IT is possible to go even further and say that many accepted art forms can be resolved back into and analysed on a mathematical basis. Many forms in nature—even everyday shapes and shadows—can be analysed in the same way.

When young ferns unfold in springtime, they can be seen as logarithmic spirals.

When light is reflected inside an ordinary teacup, the mathematician can spy a catacaustic curve. The list could be extended almost indefinitely.

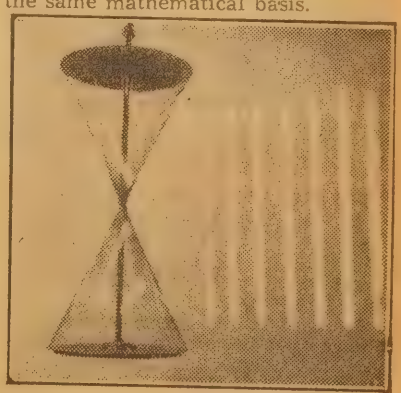
To most people, however, the subjects will never have anything in common. Many mathematicians are not art conscious while artists, as a class, are certainly not concerned with sines, cosines and powers.

In Yeshiva University, New York, however, a special group specialises in translating all manner of complicated formulas into solid figures, which look for all the world like pieces of modern art.

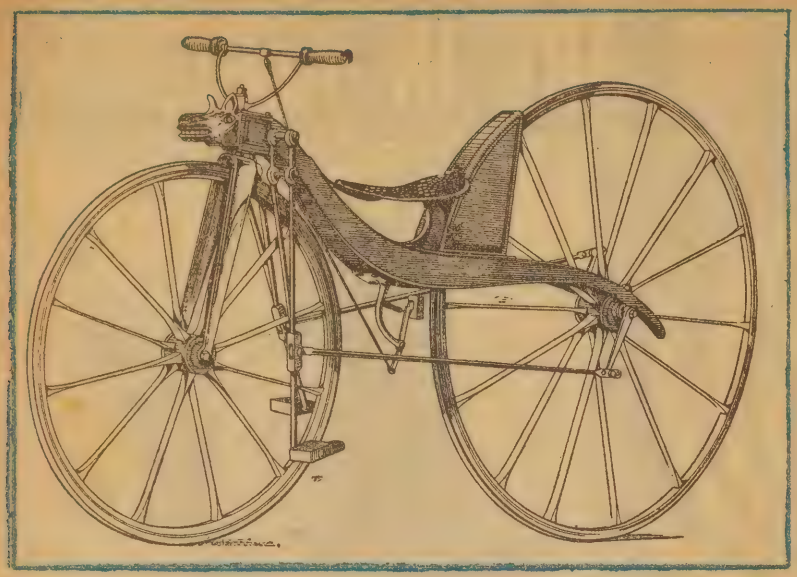
The "Scripta Mathematica," as the group and their journal is called, fashion their mathematical "statues" from numerous mediums ranging from plaster, lucite and alabaster to marble and mahogany.

Founded by Dr. Jekuthiel Ginsburg, the group is attended by eminent mathematicians, by students and even, on occasions, by members of the public, all of whom are interested in revealing mathematics as a basic art rather than merely an impassionate science.

Their headquarters are decorated with solid figures, optical gear, strange devices and knick-knacks, even card tricks and puzzles having the same mathematical basis.



A typical "Scripta Mathematic" device is a pair of discs which are joined at their edges by numerous strings. The discs can be hung straight as on the left, or twisted in relation to each other so that the strings form a complex pattern. Light images of intersecting parallel and spiral lines, as seen on the rear screen, throw intriguing patterns on the strings. Each pattern obeys a definite mathematical law.



Said to be the first cycle with rear-wheel drive, this machine was built in 1839 by a blacksmith named Macmillan. Macmillan's career was the basis of an old-time book "The Devil On Wheels."

INVENTORS HAD THEIR TROUBLES

The story of the invention and development of many of the machines which add to our everyday comfort is one of luck, hard work, tragedy and amusing incidents. Take for instance that handy vehicle, that menace of the highways (to the motorist at least) that bane of all parents who have a boy or boys from six years of age up — the push-bike!

by Calvin Walters

WE accept this phenomenon of two wheels in tandem without another thought, yet the man who invented it had to put up with all kinds of insults and derision.

When you read his name you may imagine that a man with a name like his must expect to be derided. It was Karl Friedrich Christian Ludwig Freiherr Drais von Sauerbronn. He was born in 1785 in Germany.

Karl so-and-so was a bit of a genius and showed some capacity as an engineer but his father Baron Drais, who was a Court Councillor of Karlsruhe in Baden, reckoned that an engineer was not acceptable in a family of such a high social status.

Thus Karl what's-his-name became a public servant and went around pretending to work in the guise of a forest Chamberlain. But the naughty man all this time had a secret hankering for doing something in the technical line.

THE BIG MOMENT

So one day in 1813 an amusing apparition bestrode the streets of Mannheim. Rather did it ride and bestride the streets at the same time as will be seen.

Dressed in the green outfit of the forest chamberlain, with flash shirt, lace cuffs, grey top hat and a cane in one hand, came Karl Friedrich Ludwig (and so on) mounted on a vehicle with two wooden wheels; one behind the other. Between the wheels was a wooden seat with a cushion on which sat Karl astride. With his hands he held a tiller fastened to the front wheel for steering purposes.

The vehicle was propelled by the rider alternately pushing with one foot after another on the ground. Every now and again he would lift his feet from the ground and the vehicle would sail along unaided over the bumpy cobbled street.

Needless to say every street urchin in Mannheim followed with mocking laughter and cries of derision.

For a time Karl put up with this but finally decided to prove the worth of his invention by riding from Karlsruhe to Strasbourg. This he did in four hours, one-quarter of the time it took to walk the same distance.

This remarkable feat gained the attention Karl looked for and the Government of Baden granted him a patent. There was a catch in it, however, for the patent was not valid outside Baden. Anyone outside Baden could pinch the idea. Which they did readily.

In a very short time a veritable velocipede industry sprang up and it became quite the style for fashionable people to ride about on these two wheeled affairs. It became a veritable sport but only for the wealthy. Even Royalty used them and they became known as "Dandy horses."

POOR KARL!

Karl . . . . . did not even know the reason why his vehicle could stand up. His reason for inventing it was rather novel. He claimed that a man used up too much energy by wobbling about from one foot to the other when walking. If he could keep his forward movement while remaining in the same axis he would be much better off. So Karl invented the "bike." Just like that.

But he died unhonored and unsung except for one thing. There is a vehicle which is worked by hand and used for inspecting railway lines. It was named after Karl Friedrich . . . . . Drais von Sauerbronn. It is called a "draisine." When he died in 1851 Karl had a fortune of about 60 marks. He also left some plans and models of a mincing machine, a typewriter, a cooking machine and a stove which saved fuel.

His velocipede, however, lives on. With improvements.

The first of these was thought out by one named Kirkpatrick Macmillan, a braw Scotsman from around Dumfries.

In 1839 Macmillan connected a couple of rods to the back wheel which the rider could move backward and forward with his feet and so turn the wheels. He worked on this for three years and finally decided to go for a 40-mile run from Dumfries to Glascow. It took him two days and he was "pinched" on the way and fined five shillings for endangering public safety.

REAL PEDALS

In 1852 a Bavarian fitted pedals to the bike and this led to the establishment of Ernest Michaux's factory in France where bikes were made.

The vehicle had by this time become known as a "bone shaker." Such a name was quite justifiable for they had either wooden or iron wheels without tyres. Riding about on these must have been quite an ordeal because of the cobbled nature of the roads.

From then on it became a matter of one change after another. Most of these were brought about by the bike riders themselves. Among these were the "penny farthing" bikes with

the front wheel many times greater in size than the back. The idea was to increase speed. The pedals were connected directly to the front axle.

The trouble with these contraptions was that the feats of gymnastics required to mount them made them unsafe and undignified.

The problem then became one of how to make the bike faster without the large front wheel.

An Englishman named Lawson solved it by placing the pedals and crank between the two wheels, while a Swiss, Hans Renold, invented the roller chain in 1886.

Then came an Englishman, Humber, who invented the frame as used today and later a Frenchman named Suviray contributed the ball bearings for the wheels.

When another Scotsman, John Boyd Dunlop, invented the pneumatic tyre it about put the finishing touches to a most romantic serial. The strange thing about this was that Dunlop was a veterinary surgeon.

He first conceived the idea when sitting in his garden one evening. How anyone can find time to sit in gardens of an evening beats me. But there he was, when suddenly his attention was attracted by an old length of rubber hose dumped in a corner.

Grabbing a knife, he cut off two lengths, stuck the ends together so that he had two rings. These he pumped with air, fitted them to the kid's bike and lo and behold he had the first pneumatic tyre.

From then on it was only a matter of time before tyre factories were set up. Dunlop did not make a fortune from the idea, but received enough to allow him to become a partner in, of all things, a curtain factory. He died in 1921 after seeing the world covered with tyres, which netted millions to the makers.

AND THAT'S THAT

And so the humble bike goes down in history as one of the most international inventions of all time. Every one had a hand in it and today everyone has had a bike at some time or another. And if Dunlop the vet. could see how many dogs and cats have been run over because of his tyres, he would have probably wished that he had never seen that bit of old hose in the garden.

Turning now from bikes to moving pictures we find a strange mixture of circumstances. It all began in the year 1794 with the retirement from Napoleon's army of an officer named Nicephore Niepce.

This gentleman had a flair for natural science and conceived the idea that light could be used to make pictures by means of chemicals.

Centuries before Niepce, the famous Leonardo da Vinci thought up a box with a small hole in it through which the light shone and threw upside down pictures on the opposite wall of objects in front of the hole.

Niepce, however, improved things by putting a lens into the hole. He then discovered that if a piece of asphalt was exposed to the rays those parts of the asphalt so exposed became insoluble in vegetable oils and he could get a picture—of sorts—after several days' exposure.

Niepce also drew line drawings on the plates, and after washing them with oil etched them with acid. This was the first photo-mechanical printing scheme. He then found that silver iodide used as a base for the asphalt improved results considerably. Unfortunately, he did not think of using the silver iodine alone. He would have discovered that it was the stuff be really wanted. He could have done without the asphalt.

After fooling around for about 20 years, Niepce met a decorator, Louis Daguerre, who was working along the same lines and they formed a working partnership. Nothing much happened up to the time of Niepce's death at the age of 89.

Daguerre had discovered that iodine-silver was better than asphalt for sensitising the plates, but could never get a decent picture.

LUCK STEPS IN

Hence the element of luck came into the picture. Daguerre had put a few underexposed plates in a cupboard whence he had intended to extract them later to use again.

After a few weeks he got them out, but to his surprise found them converted into beautiful pictures.

Daguerre frantically searched the cupboard for that which had developed the plates, but found nothing. He exposed more plates and put

THE BIGGEST 1½d. IN THE WORLD!

From the museum of the Brooklands racing motorist, R. G. J. Nash, comes this enormous "Penny-Farthing." Built in 1884, it employs an 84-inch wheel, the largest of its kind ever made. Extensions allowed the rider to manipulate the pedals.

The difficulties of early still photographers—let alone "movies"—are emphasised by this exhibit from the George Eastman museum. With the aid of an assistant and a portable darkroom, the photographer had to sensitise his plate and expose it while still wet.

'H.M.V'S' NEW AUTOCHANGER

GREATLY SIMPLIFIED AUTOMATIC CHANGING UNIT

Working Parts Reduced

With this entirely new and simplified automatic changing unit, the operator is able to handle up to ten 10" or ten 12" records (unmixed) at the one loading. "H.M.V." have designed the autochanger so that there are as few working parts as possible. As there is no complicated mechanism, the autochanger is operated with the greatest of ease.

Knob Control

The autochanger has several other features which make operation very simple and convenient. The operator can reject a record whenever he pleases, with the single knob control. When the last record has been played there is no need to touch the pick-up. The mechanism is switched off automatically.

Lightweight Pick-Up

The special lightweight pick-up gives sparkling clarity of tone and the highest quality of reproduction. Gramophone needles and records have a much longer life than usual.

Precision Camwheel

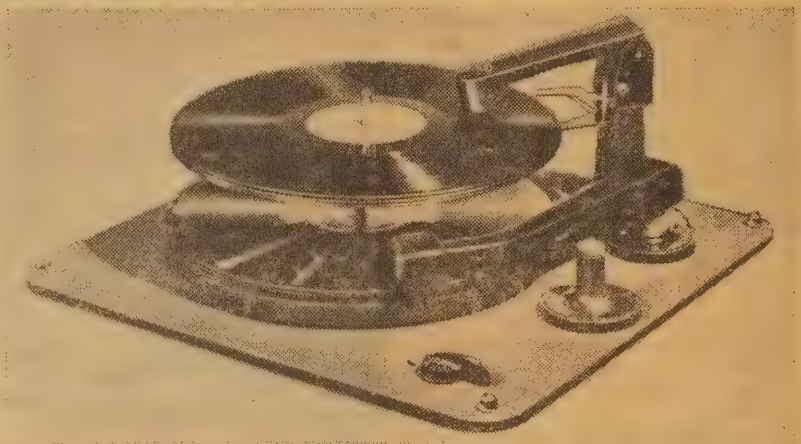
The precision camwheel governs the main sequence of operations. It follows, then, that there is no need for critical adjustment of the timing. The reason for this is that the operating stops and pins are accurately located in moulding the camwheel. When the autochanger is being used it has been proved virtually foolproof. As an instance, the pick-up can be handled during the operating sequence without damage to the mechanism. Should the operator wish to play single records the pick-up can be handled in the normal manner.

Matching Transformer

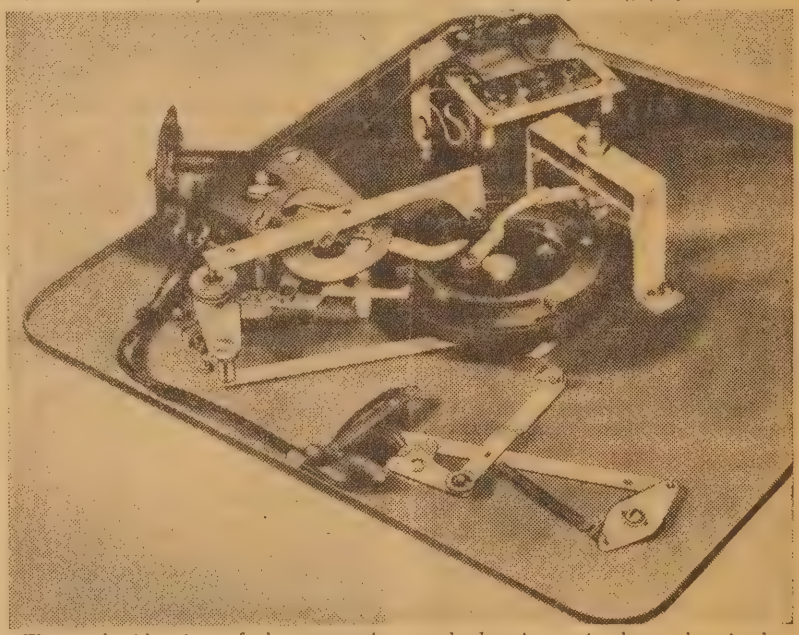
As the pick-up is of low impedance a matching transformer is provided. This transformer enables an output of approximately 1.5V R.M.S. with records that are considered average. The purchaser can obtain the unit without the transformer if he so wishes.

Maximum Reliability

The outstanding feature of "H.M.V.'s" NEW autochanger is that it has been built in a greatly simplified form. Obviously, the fewer the number of working parts, the fewer the number of complications that can arise.



TYPE AC 100 Topside view of the autochanger in operation, showing the single knob control used for starting and rejecting. The lightweight pick-up (shown above) may be handled while records are actually being played.



This underside view of the automatic record changing unit shows the simple construction. The operating camwheel which controls the sequence of operations is seen in the centre.

Supply Voltage

"H.M.V.'s" automatic record changing unit, type AC 100 operates from 50 cycle, A.C. mains supplies. 100-130 or 200-250 volts.

All Radio Retailers

"His Master's Voice" autochanger is obtainable from all leading radio retailers. The unit costs only £17/10/-. This is remarkable value for a record changing unit with so many EXTRA features.

"HIS MASTER'S VOICE"

The Hallmark of Quality

"HIS MASTER'S VOICE"

THE GRAMOPHONE COMPANY LTD.
(INCORPORATED IN ENGLAND)
HOMEBUSH, N.S.W.

R27-52

them in the cupboard. The same result. He went over the cupboard with a magnifying glass and found a few small drops of mercury, which had become spilt. This was the culprit.

The photograph had come into existence. It became popular to sit for a couple of hours in the hot sun for an exposure to be made.

We must pass over the work of the Englishman Fox Talbot, who invented the photographic negative and the work of Maddox and Swan in their contribution of the dry photographic plate and speak somewhat of cinematography.

The tragedy of invention and research can best be illustrated by the case of the Belgian scientist, Joseph Plateau, who gave his eyesight in the cause of science.

THE HARD WAY

From the age of 28 he investigated the effect of gazing steadily into the sun for periods of 25 seconds. He would recover his eyesight only after a month, but persisted until at the age of 42 he was totally blind which, in the end, he knew he would be.

In doing this Plateau discovered the mechanism of sight. He found that images remained on the retina for one-sixth of a second and thus laid the foundations of the moving picture. He discovered principles which made the curing of bad eyesight possible.

From the discovery of the persistance of vision came many toys based on the idea of looking through slits at revolving figures which gave the appearance of motion.

In what country the moving picture was really invented is still a matter for argument but one of the first records tells of an Englishman, William Friese Greene, who took the celluloid invented in 1859 by the Birmingham gent Alexander Parkes and used it to make a series of pictures. He built a special camera with which to show the pictures, each of which measured 4in by 3in.

After "shooting" some scenes in Hyde Park and in London streets he set up his gadgets in a Holburn workshop and projected them on the whitewashed wall. The "show" was so realistic he rushed into the street at midnight and in great excitement dragged a "bobby" inside to see what was doing. At a later date he showed a picture of himself in varying expressions, ending in a "wolfish" wink which was so realistic that a lady in the audience poked the screen in with her umbrella.

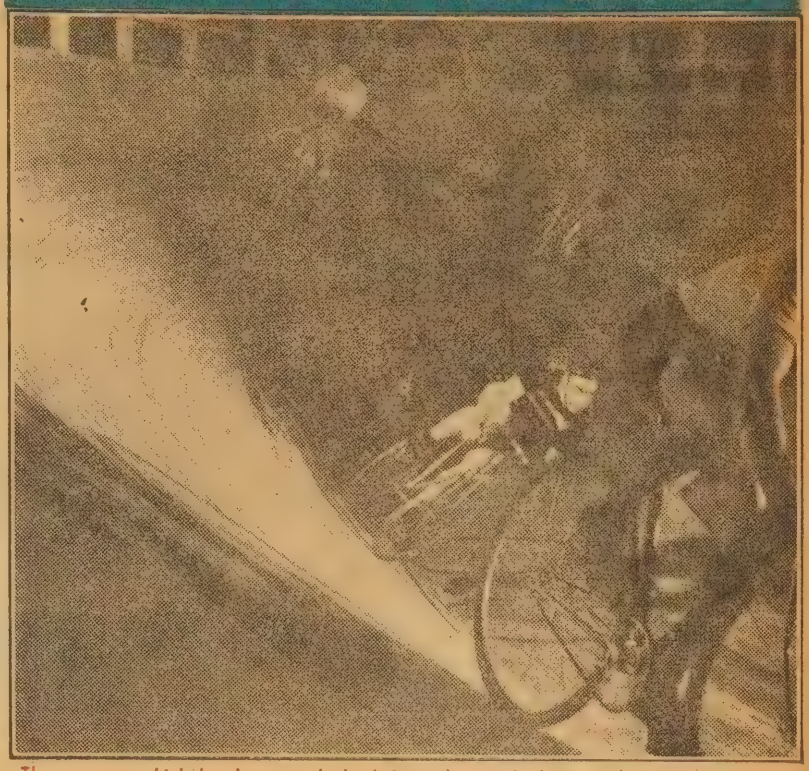
EDISON'S EFFORT

Then, of course, we have the inevitable Edison, the American claimant for the title.

Edison first tried small pictures on spiral formation on glass cylinders but the idea was a "washout." Then in 1889 he obtained the new roll film in a 50ft roll. He took 158 single pictures, each of which took one minute to expose. By running this through a machine which he invented he was able to get a fairly good semblance of motion.

By various improvements Edison developed the "Kinetoscope," a machine into which a coin was inserted to set it in motion.

SPEED IN CYCLE AND CAMERA



The progress which has been made both in cycling and photography could not better be indicated but by this picture. Taken on a track at Chicago during a 6-day cycle race, the exposure was taken in 1/5000th second sufficient to "freeze" even the whirling wheel spokes!

France, Germany and other countries had their inventors of the moving-picture. On the Continent considerable development took place and the profession of "Cinematograph Operator" became a fashionable one.

The operator in many cases owned his films and, of course, he was very important. He wore top hat and tails and came in front of the screen at every performance and took a bow. He usually filled in the time between reels by telling funny stories. Sometimes the machine would be faulty and the picture would suddenly black-out when the voice of the operator would be heard, advising patience as "the bleedin' thing's got stuck again."

One of the worst faults of the early films was the flickering caused by the moving across the screen of each picture in rapid succession. This was overcome by the "Maltese Cross" invented by a Berlin optician Oskar Messter. This idea gives a smooth change from one picture to the next while the diaphragm shuts off the light.

Today, of course, the cinematograph has been brought to a high state of perfection but only again by international co-operation. Behind it is the brain work of men of all nationalities.

BETTER BUTTER MADE WITH AIR

ELECTRICALLY controlled air-power brings increased efficiency to butter making. This process consists, fundamentally, of turning the butters fats in cream into butter granules by means of agitation, washing, brining and finally forming them into a homogeneous mass.

The equipment employed ranges from the traditional milkmaid's churn to the industrial installations of butter factories. The latter's vast output sometimes falls below the exacting standards of quality essential to this appetising food. Granules of unequal size resulting from the technical difficulty of assuring uniform mechanical agitation throughout a bulky volume of cream, may give an unsmooth texture, while mild tainting can be caused in so odor-sensitive a material by smelly lubricants.

Difficulties such as these are overcome by a new machine made in England. It works on the novel principle of air agitation. The cream is agitated, not by a moving paddle or bar, but by a continuous stream of air under pressure.

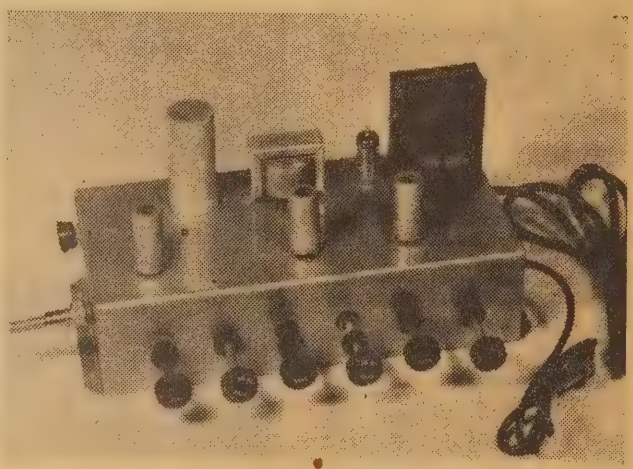
The butter-maker, which is produced in both farmhouse and industrial sizes, uses electricity to create the air stream. An electric blower connected by tubing to the churn forces air through a centre piece, so designed as to assure butter of very high granular quality in some 20 minutes. To wash the granules, water is circulated by the blower, brining is carried out by first blowing salted water round the granules, and then allowing them to soak in it.

"Fidelity" Sound Equipment

MANUFACTURED BY AUDIO ENGINEERS PTY. LTD.

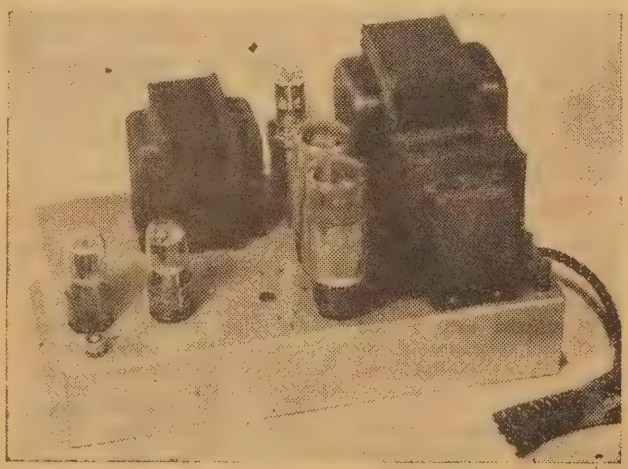
THE WILLIAMSON TONE CONTROL £36/-/-

The Williamson Tone Control (as designed by P. T. N. Williamson) is suitable for use with any Amplifier having an input impedance of .5 megohm or greater and requiring an input Voltage of .25 volts to 2.5 volts.



SPECIFICATIONS

Overall gain 10
Frequency Response 20—20,000 cycles
Input Impedance .5 megohms
Valves — 3, 6AU6; 1, 6X4
Radio Tuner Power Supply—350V at 20m.a.; 6.3V at 2 amps
Sharp cut-off Variable filter provides 40 DB per octave attenuation at 5, 7, 10 and 13 KC.
Bass Control max. cut — 12DB at 20 cycles
max boost + 20DB at 20 cycles
Treble Control max. cut — 17DB at 20,000 cycles
max. boost + 17DB at 20,000 cycles



OUR LATEST MODEL WILLIAMSON AMPLIFIER £49/17/7

Features Single chassis construction. Low hum level. Output Transformer 15 ohms or 3.75, other impedances to order. Uses 2 6SN7GT Valves, 2 KT66 Valves and 1 5V4G Valve.

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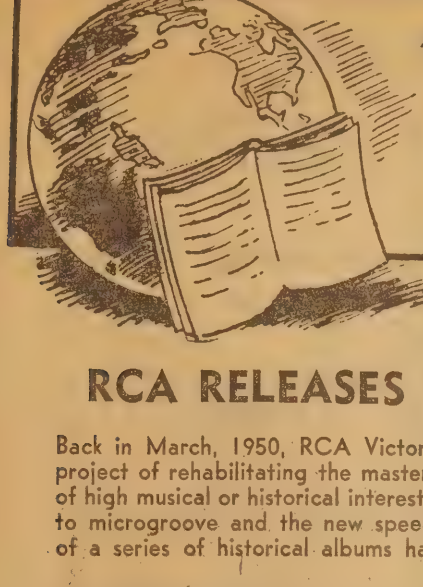


Technical Review

RCA RELEASES TREASURY OF OLD RECORDINGS

Back in March, 1950, RCA Victor embarked on a project of rehabilitating the masters of old records, of high musical or historical interest, and transferring to microgroove and the new speeds. Now the first of a series of historical albums has been released.

IN the first place, some 2000 masters were examined. From them were chosen 300 recordings which seemed most valuable artistically.

Then these old masters were subjected to the most painstaking and meticulous repair work. Ticks, pops and other extraneous noises were removed, as far as possible. They were then transferred to tape, first selecting a pickup that would give the highest fidelity and lowest surface noise.

It was during this operation that all the devices known to the art, such as filters, compensators and transfer turntables, were brought into play in order to improve the quality of the musical content, reduce distortion, &c. In a number of recordings, excerpts from several parts were pieced together in order to assemble one side that was good overall.

The acclaim which the "Treasury of Immortal Performances" received from dealers and public proved that this care was well applied. More than a quarter of a million albums of the first edition of the Treasury were sold.

During this month (January, 1952) the second Treasury, consisting of seven volumes of classical music and twelve volumes of popular music, is being published. Among the classical albums there will be, of course, another Caruso album.

For the first time also, both John McCormack and Rosa Ponselle will be featured in individual albums.

The other albums are Famous Duets, Pianists of the Past Play Chopin, Stars of the Golden Age, and a new idea, Aida of Yesterday, a presentation of excerpts from the world's most popular opera sung by Caruso, Homer, Martinelli, Ponselle, Gadski, Amato, Pinza, Rethberg and Gigli.

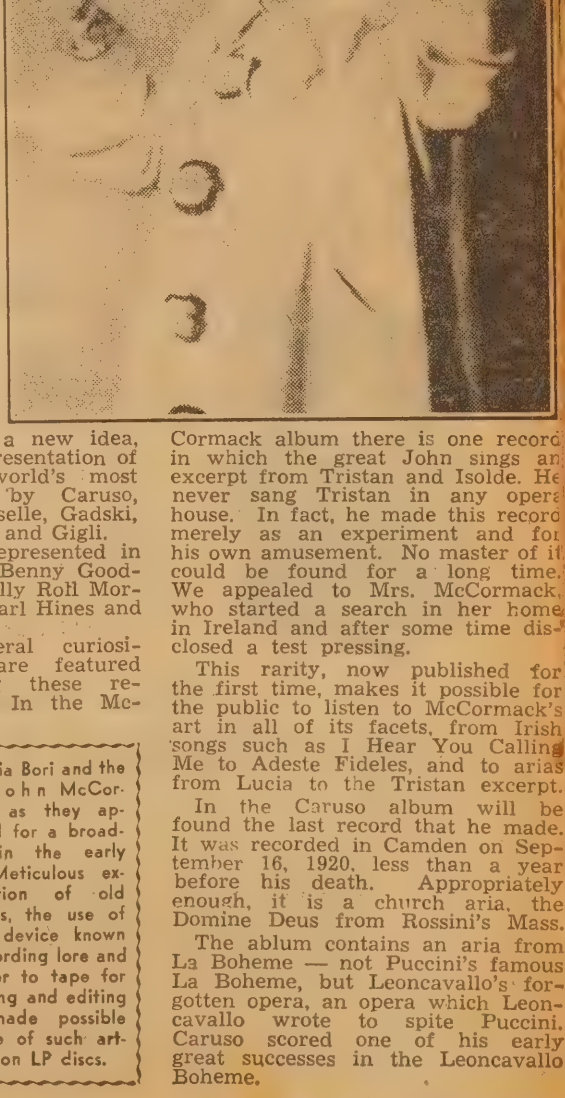
Among the artists represented in the popular series are Benny Goodman, Sidney Bechet, Jelly Roll Morton, Lionel Hampton, Earl Hines and Billy Eckstine.

Several curiosities are featured among these records. In the McCormack album there is one record in which the great John sings an excerpt from Tristan and Isolde. He never sang Tristan in any opera house. In fact, he made this record merely as an experiment and for his own amusement. No master of it could be found for a long time. We appealed to Mrs. McCormack, who started a search in her home in Ireland and after some time disclosed a test pressing.

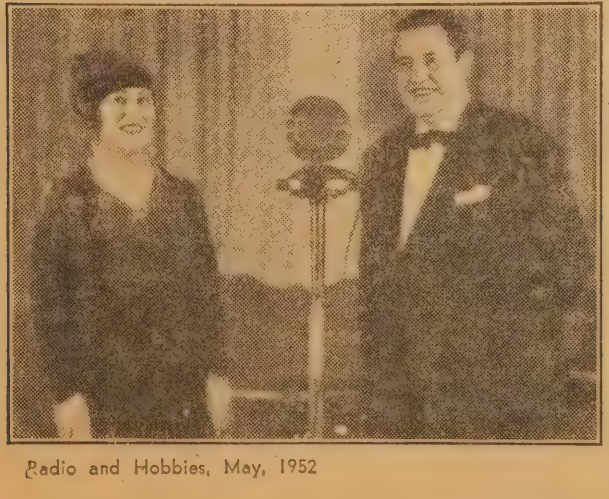
This rarity, now published for the first time, makes it possible for the public to listen to McCormack's art in all of its facets, from Irish songs such as I Hear You Calling Me to Adeste Fideles, and to arias from Lucia to the Tristan excerpt.

In the Caruso album will be found the last record that he made. It was recorded in Camden on September 16, 1920, less than a year before his death. Appropriately enough, it is a church aria, the Domine Deus from Rossini's Mass.

The ablum contains an aria from La Boheme — not Puccini's famous La Boheme, but Leoncavallo's forgotten opera, an opera which Leoncavallo wrote to spite Puccini. Caruso scored one of his early great successes in the Leoncavallo Boheme.



Caruso is one artist who has earned more money since his death than he earned in life at least from recordings. Total earnings before his death in 1921 were about one million dollars. Since then his recordings have earned in royalties another two million dollars.



Lucrezia Bori and the late John McCormack, as they appeared for a broadcast in the early 20s. Meticulous examination of old masters, the use of every device known in recording lore and transfer to tape for patching and editing has made possible release of such artists on LP discs.

SOLVE YOUR PROBLEMS
WITH **TAYLOR** TEST EQUIPMENT

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MUTUAL CONDUCTANCE VALVE AND MULTITESTER

Fitted with large direct reading meter with illuminated dial and OVERLOAD PROTECTION. Tests over 2000 American English and Continental valves including latest types. Filament volts range from 1.1 volts to 117 volts. Filament continuity and element shorts shown directly on meter. Cathode leakage read in megohms. The instrument is housed in a solid oak carrying case and supplied with comprehensive instruction manual. Also available as valve tester minus multitester ranges—Model 45 A-S.

MULTITESTER RANGES. 1000 ohms per volt A.C.-D.C.

D.C. Volts	D.C. Current	A.C. Volts	Resistance
0-120 m.V.	0-0.6 mA	0-3	0.5-22.5-1000 ohms.
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

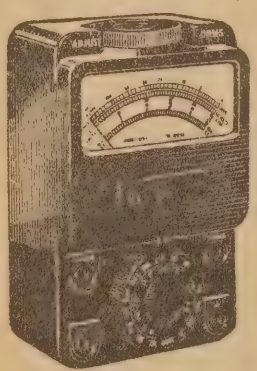
IMMEDIATE DELIVERY

MODEL 75A

RANGES 20,000 ohms per volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0—1000	0—1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.



MODEL 120A POCKET MULTIMETER

RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

DIMENSIONS: 4⅞" x 3¼" x 2"

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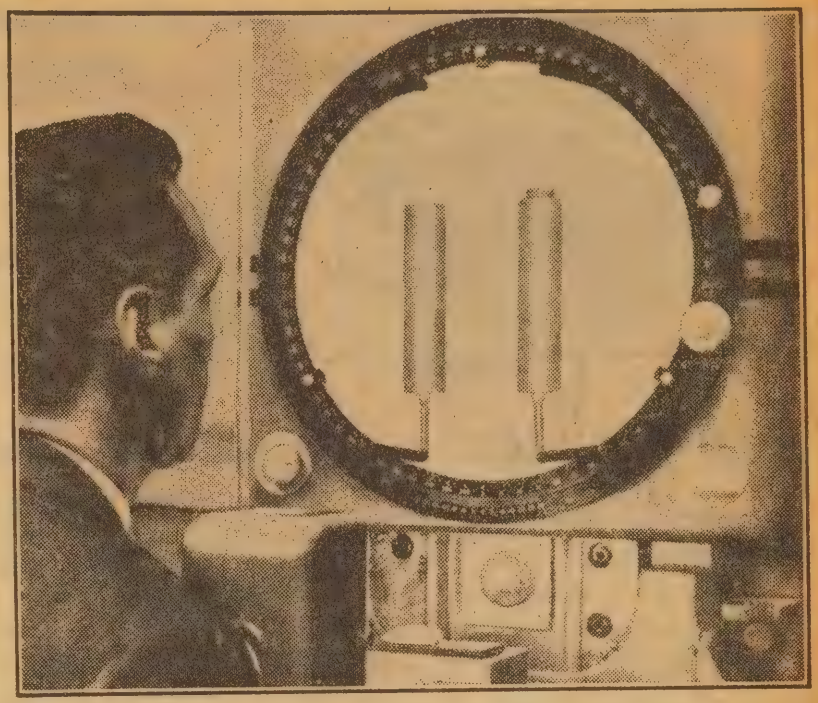
Taylor Best for TEST EQUIPMENT

Manufactured by:—TAYLOR ELECTRICAL INSTRUMENTS LTD., GREAT BRITAIN

GENERAL ELECTRIC TELLS STORY OF CRYSTAL DIODES



Contour projection of diode parts for microscopic inspection. Pellet and whisker, shown enlarged on the screen, must follow very rigid specifications.

In the latest issue of its two-language magazine "Dial," the General Electric Company of America tells the story of the development and production of the modern crystal diode. It is rated as one of the most interesting and useful devices available to the electronics engineer.

THE theory of semi-conductor rectification has been known for many years and in fact the galena crystal and cat's whisker device was the beginning of radio. However, with modern techniques plus the use of germanium as the crystal, it has been possible to produce miniature sealed units useful in all fields of electronic circuitry where it is necessary to convert low power alternating current to direct current.

The General Electric Company has been making commercial germanium diodes for five years and is now the largest producer. In January, 1951, the manufacturing facilities were expanded fourfold and moved to a new plant devoted exclusively to the manufacture of germanium products.

INITIAL USES

The first germanium diodes were used for meter rectifiers, clippers, limiters, and miscellaneous other low power rectification applications. Soon designers of high speed computers found that considerable space could be saved by using them in place of vacuum tubes. Where thousands of tubes, each requiring filament power were formerly used, germanium diodes could be crowded into tiny spaces and the large filament supplies, associated wiring, and tube sockets could be eliminated. Complicated switching circuits, adding and subtracting pulse circuits, and isolation circuits used them to great advantage.

Probably foremost in promoting widespread usage of diodes was the television industry. Emphasis was on lighter, smaller chassis with fewer tubes. Germanium diodes were ideal. In television receivers they are used as video detectors, d-c restorers, sync separators, limiters, discriminators, and ratio detectors. Over two million were used by the television industry in 1951.

Following the television trend, a special germanium diode was developed by General Electric for use as a mixer diode in the proposed 500 to 1000 MC UHF band. These UHF diodes are finding their way into other high frequency applications such as meter rectifiers, detectors, and frequency multipliers.

Today, with the emphasis on military development, diode usage is growing rapidly. This is particularly true in aircraft equipment and ballistics where weight and size are paramount. Stiffer specifications of shock, vibration, life, and humidity protection must be met.

DIODE CHARACTERISTICS

In considering the use of germanium diodes, the design engineer must keep in mind several differences between the crystal rectifier and a vacuum tube rectifier. The forward conductance of the crystal is higher than a vacuum tube, resulting in lower losses.

Low voltage response is better, due to the lack of contact potential. The shunt capacity is also lower and the operating life should be considerably longer.

On the other hand, there is a finite flow of current to reverse voltages resulting in some undesired loss. This is generally not detrimental as long as the proper type is chosen to give a sufficiently high back resistance for the application. Then, too, the resistance value will change with temperature which must be considered in the circuit design.

From the above it can be seen that the three most important ratings of germanium diodes are forward resistance (usually measured at plus 1 volt), back resistance (usually measured at minus 50 volts), and peak inverse voltage.

RAPID DEVELOPMENT

The technical development and improvement of the General Electric germanium diode has been both continuous and rapid. The design engineers have been backed up by continuous research by the Electronics Laboratory and the Research Laboratories.

The first General Electric Germanium Diodes introduced were made in a metal shell with a glass insulating bead supporting the whisker assembly. This method of manufacture proved to be expensive and the metal case added considerably to the electrical capacitance.

In 1948, a plastic case was introduced with savings in cost and improved electrical performance.

It was at this time that the diodes were registered with the Radio Manufacturers' Association and several types introduced to meet the various market requirements. These were the 1N48, 1N49, 1N50, 1N51, and 1N52. Later, the 1N49 and 1N50 were dropped and the 1N63 was added. These four remaining types (1N48, 1N51, 1N52 and 1N63) still form the backbone of the now larger family of some 30 types.

FIELD FAILURES

In the summer of 1949, field failures brought to light several basic weaknesses. Summer temperatures and high humidities caused the plastic cases to absorb moisture, expand, and physically pull the cat's whisker from the germanium.

Steps were taken to overcome the difficulties, among which a change in case material was the most significant. The original material used was a wood flour base thermosetting plastic. The new material, which uses a glass instead of a wood flour-filler, is believed to be the ultimate in a plastic material for this particular application. It is the most stable thermosetting plastic known with respect to moisture-absorption and temperature effects.

In addition to this change, the assembly machines were redesigned to assure a "follow up" or compression of the whisker against the germanium of .002in. to .003in., so that under extreme conditions there can be no

two of the best...

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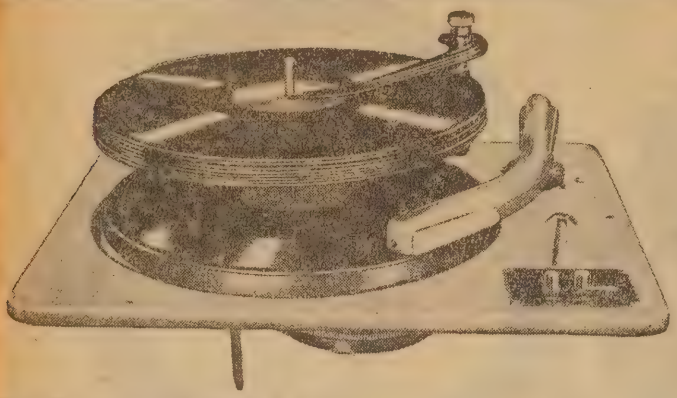

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1. With only three moving parts the COLLARO always remains in adjustment and cannot jam.
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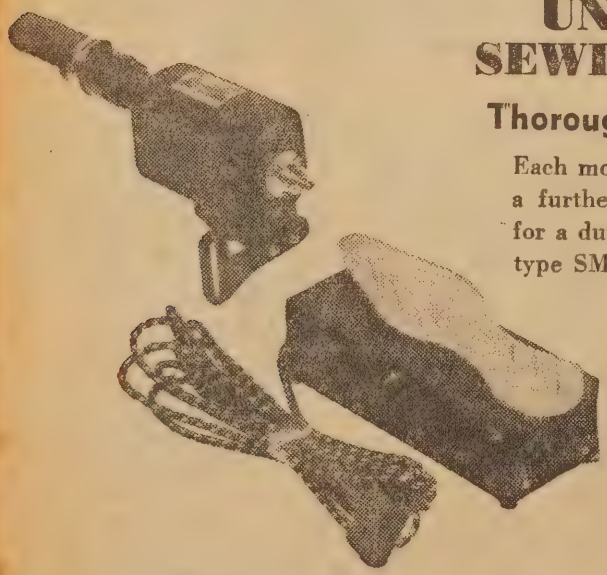

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Thoroughly Tested — British Throughout

Each motor has been given a 50 per cent overload test with a further test of 1,000 volts between frame and windings for a duration of two minutes. Illustration is type HSU, and type SM5 is also available with a different light mounting.

Specifications

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- **Runs on AC or DC current.**
- **Self Oiling bearings.**
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E1738

RADIO SPEEDS WORK ON WORLD'S LARGEST PIPE LINE

Construction and operation of the World's largest oil pipe across more than a thousand miles of desert wasteland from the Persian Gulf to the Mediterranean Sea represents a modern wonder achieved by a combination of radio and petroleum engineering.

Showing the route of the 1000 mile pipeline which saves over 3500 miles of sea route. Main factor which made the project possible was the use of radio communications both during the construction and to facilitate routine maintainance when completed.

SUCCESSFUL 24-hour operation of the oil highway, which traverses four countries—Saudi Arabia, Jordan, Syria and Lebanon—depends upon reliable radio communications. RCA was entrusted to design and install a radio system between terminal points and the six pumping stations that control the daily flow of 300,000 barrels of oil.

Tapline, the abbreviated name commonly used to identify this project, was built by the Trans-Arabian Pipe Line Company and the Arabian American Oil Company. It cost more than 200-million dollars and required more than 265,000 tons of steel pipe.

The history of Tapline started with the discovery of oil in commercial quantities in Saudi Arabia. The oil there is close to the Persian Gulf, but by tanker route it would have to be carried 3500 miles to the Mediterranean, by way of the Indian Ocean, the Red Sea and through the Suez Canal.

LONG SEA ROUTE

Looking at their maps, oilmen saw that tremendous savings in time and money could be made by piping the oil across the Arabian Peninsula. After extensive planning and study, construction on the pipe line was begun in the summer of 1947.

Installation of a radio circuit between Tapline's main office in Beirut on the Mediterranean and Ras el Mishaab on the Persian Gulf was the first major task. In one month, this circuit was completed and was carrying executive telephone and teletype traffic.

As work progressed along the pipe line, engineers provided communications for field construction units, camps, motor caravans, supervisors and survey parties. At all times, field personnel was in radio contact with either Ras el Mishaab or Beirut.

The completed system, as operated today, has the following specialised functions: (1) dispatching pumping operations, (2) airway and vehicular communications and (3) dispatching movements of oil tankers.

Communications for pumping operations consist of parallel telephone and teletype circuits. Signals from the various pumping stations are received by an automatic repeater station at Rafha, midway on the pipe line, and retransmitted from there to other points.

Through the use of automatic repeater operation and frequency diversity, nearly 100 pc reliable telephone service is available between the pumping stations and the terminals at Beirut and Ras el Mishaab. For security purposes, a method was developed whereby all voice communications may be encoded into more than a hundred different combinations.

In place of wire lines between Sidon and Beirut a VHF circuit is employed which is designed to carry eight voice channels as well as two teletype channels and two control channels.

STORY OF CRYSTAL DIODES

(Continued from Page 21)

pulling away of the whisker from the germanium.

However, moisture was found to have other effects on germanium. Moisture at the junction of the whisker and germanium causes an apparent enlargement of the contact area and also produces electrolytic and crystalline structure changes, resulting in decreased resistances of the diode.

To overcome the possibility of moisture penetration of the case, the units were wax impregnated. This was done by putting complete units in a commercial vacuum, then forcing wax into the microscopic pores at 150 deg. C and 35lb pressure. This protective treatment is still part of the manufacturing process.

It was at this time that rigid quality control checks were incorporated. Continuous tests were made on sample lots at high temperatures and humidity. These tests were made for 1000 hours at 40 deg. C and 95 pc relative humidity.

Shortly after these steps were taken, the engineers sought ways to improve further the quality and, if possible, lower the costs. The humidity test was stepped-up to provide a more rigid test and shorten the time cycle. It was changed to 65 deg. C and 95 pc relative humidity. in cycles of 8 hours on and 16 off.

Results formerly obtained in five weeks became available in five days.

In June, 1950, after a year of research, the design was modified to incorporate all the changes found to be helpful in prolonging the life of the diode. The case shape was changed to increase the wall thickness and to provide better cementing of the metal parts. Pins were used on both ends instead of at just the whisker end, paving the way for snap-in mounting. At the same time, the pin material was changed from steel to grade A nickel to give better bonding of the cement, and their larger size and increased thermal capacity helped to protect the germanium from the adverse effects of soldering heat.

The leads were changed from .025 diameter copper to .020 diameter copper-clad steel, giving greater strength and flexibility and allowing only one-fourth as much heat to be conducted to the germanium during soldering.

As the applications of germanium diodes are increased, new properties are investigated. The low impedance, high efficiency, ultra-high frequency diode is an example of research into what was necessary to provide useful diodes at 1000 mc. The use of diodes in pulse circuits has brought to light many new diode characteristics.

Current flow characteristics of submicrosecond duration become predominant and have resulted in investigations of drift characteristics. The majority of these problems have been solved by pulse curing of the germanium during manufacture first at high voltage and then at high current.

BAKING TECHNIQUE

All diodes are now baked at 105 deg. C for 24 hours. This has had the effect of better curing of the cement and plastic case, as well as stabilising the germanium. Investigations for further improvements are continuing. And there are long-range plans, totally new designs and new products. Ultra-high frequency and microwave use of diodes, as well as the transistor (a germanium triode) and photo amplifier are only the beginning.

The newest additions to the germanium product family are the germanium power rectifiers which are really revolutionary. They are built on the principle of junction rectification as opposed to point contact. Most important is the fact that their efficiency is extremely high. The forward resistance is negligible and the back resistance is as high as point contact types.

RECORDEX—33/6

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- Holds 50 10" or 12" records.
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The WARBURTON FRANKI Page

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Features easy knob change of speed

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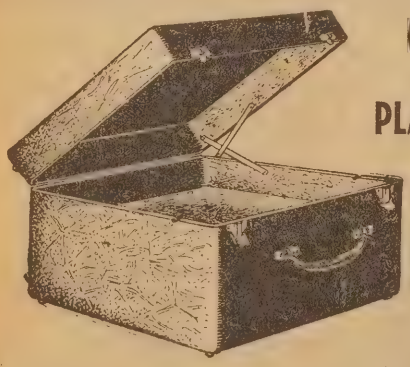

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Acos GP20 Microcell Pickups - **£6/3/6**
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NEWS AND VIEWS OF THE MONTH

High cost of T.V.

REPORTS from USA indicate that TV broadcasting is suffering or is about to suffer from a severe attack of high prices.

In the initial enthusiasm for the new art and the big money which was to be earned in it, astonishing fees were paid to artists, many of whom came from the film industry. This was the direct result of the search for bigger and better programmes as set owners began to lose the first fine rapture of seeing television programs at all.

It seems, however, that even the American publicity machine hasn't bottomless coffers. A halt apparently has been called, and many of the top names are leaving television in favor of other activities, with emphasis on radio.

Some of this movement may be due to world conditions as they effect American finance. But it may also be an indication that the cost of elaborate program must act as a restrainer in setting a standard, and point the way to a closer amalgamation between television and the other entertainment fields.

Some time ago we gave as an opinion that TV was big enough to swallow all other forms of entertainment if first grade programs were to be supplied all the time. If this is not literally true, we may be entering a second phase of this TV business where the coat must be cut to the limitations of the cloth.

It seems clear that a new era of interlocking the entertainment fields seems about to begin. TV is too big to fight—it must be used.

Once many thought that the broadcasting of records would kill the gramophone industry. For a while it nearly did so. But eventually the two came to terms, and now it is as hard to imagine records without broadcasting as it is in the reverse.

A point was made by an advertising executive recently returned after an eight-weeks' TV study in USA. He told of a half-hour show recently televised in San Francisco which cost nearly £19,000, and thought that Australia could hope to provide only the simplest type of programs.

The development of TV all over the world will present an absorbing and invaluable study during the next two years. We may see not only an interesting regrouping of entertainment fields, but the growth of a new technique aimed to combine saleable results with reasonable cost.

★ ★ ★

A.W.A. show

DURING the Royal Show period, AWA turned on their own radio show in the beautiful foyer of their famous building. The equipment on display gave effective evidence of the wide field covered by this company in the radio-electronic field.

The most eye-catching feature was a display of wired television in which studio events, as well as shots of Sydney from the big tower, were televised.

A most ingenious machine which pitted its skill at "noughts and crosses" against any opponent offering intrigued many visitors. Nobody succeeded in beating the machine, and it wasn't for want of trying!

★ ★ ★

Endurance feat

THE WIA Federal Convention held in Sydney during Easter began about 2 pm on Good Friday and continued night and day with the exception of Sunday morning until noon on Easter Monday. That's an endurance feat if you like, and enthusiasm as well.

In that time 82 items of business were considered, in addition to a number of general items not on the agenda.

The Convention is held at Easter time to ensure a representative from each State can attend. Fortunately there has been a full attendance at each Convention since the war, some Divisions sending an observer as well.

It's doubtful whether amateurs generally appreciate the hard work put in by their representatives at these Conventions. Looking at some of the items which appear it's a pity they are not dealt with on the administrative level during the course of a year. If only vital points were raised—particularly those where a free interchange of opinions is needed for decision, the various delegates would not find the job so long and arduous, remembering that certain

POPULAR SCIENCE QUIZ

Q. How does a hand-type fire extinguisher operate?

A. There are three types of hand fire extinguishers in general use at the present time. In most buildings not fitted with fire-extinguishing installations, you will find the familiar "soda-acid" type which is used for "ordinary" fires.

The second type, the "carbon tetrachloride," and the third type, the "foam," are used for fighting "electrical" fires or "oil" fires. These two types produce a heavy vapor in one case and a thick foam in the other which settles over a small fire and smothers it. The use of a "soda-acid" extinguisher on such fires would be dangerous to the operator in the case of electrical fires and would serve simply to spread the burning liquid in the case of an oil fire.

The soda-acid extinguisher consists of a fairly large container carrying a solution of bicarbonate of soda. A small jar with a loose-fitting stopper and containing concentrated sulphuric acid is suspended above the solution. The pressure in the extinguisher when in this upright position is that of the atmosphere, just on 15lb per sq. in.

When required, the extinguisher is turned upside down causing the sulphuric acid to pour out of its jar into the solution of bicarbonate of soda. This mixture produces a large quantity of carbon dioxide gas which quickly raises the pressure in the extinguisher to something approaching 75lb per sq. in. The increased pressure forces the contents out of the nozzle to produce a stream capable of reaching a point 30 to 40ft away.

The water stream with carbon dioxide dissolved in it soaks the material burning, tending to cool it below the kindling point and to exclude the air.

Q. Why does the taste of water change after boiling?

A. This change, so familiar to everybody, is due to the removal of the dissolved gases contained in the air and to the "burning" of organic matter present in varying degrees. Distilled water, that is, the condensed vapor of boiling water, has much the same taste.

The somewhat "flat" taste of boiled or distilled water can be improved by allowing air to dissolve back into it. This can be achieved by pouring the liquid back and forth from one container to another.

Q. Why does iron rust when exposed to the air?

A. The "rusting" of iron is a chemical change known as slow oxidation. In contrast, the burning of wood or other inflammable materials is known as rapid oxidation. In this chemical change, oxygen present in the air unites with the substance and, in the case of iron, forms a new compound called iron oxide, or more generally, "rust." Other metals such as zinc, copper, tin, &c, produce oxides freely only when heated.

Building structures, utensils and other objects made of common metals can be treated to prevent slow oxidation. Paint can be used, because it is made up of materials which unite easily with oxygen to form a tough coating when it dries.

Another treatment is the plating of objects with tin or zinc, the tin plating being used for cooking utensils and zinc plating for such items as buckets, tubs, &c. The latter treatment produces "galvanised" iron, a more familiar term. Allovs such as stainless steel do not oxidise because oxygen will not combine with them.

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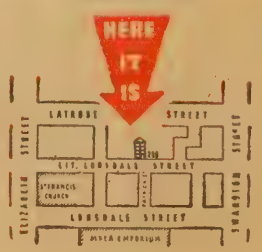
208
LITTLE LONSDALE STREET



MELBOURNE—VICTORIA

of them must travel many hundreds of miles there and back.

The Conventions are exceedingly valuable to amateur radio, and will increase in value as the proposed amateur program gets under way. It is to be hoped that the idea of having Conventions at two-yearly intervals does not find favor. This is too long a period to ensure unity in thought and action in a body so widely scattered over so vast a continent.

★ ★ ★

News of Ourselves

IT'S not often that we consider our own doings as rating a news par such as this. But we think our new mantel receiver described in this issue is an exception.

Many years ago we described a mantel set called the Little General. It was near enough to being the first really simple set of its kind designed against a definite requirement, and not specifications based on a salesman's ideas.

We couldn't see why the owner of a mantel set should pay for sensitivity and volume he couldn't and would not use, if by other means we could cut size and cost in half. Result—the Little General is still probably the most popular baby set in Australia.

Our new design is really a restatement of the idea behind the Little General of 1939. But components have improved and ideas have matured since then. We think we can now give you a little set with only three valves all told, which will play all your local stations as loudly as you could wish, and which will give you as much undistorted output as a modern, more efficient loud speaker requires.

Just as the Little General appeared in various forms in the catalogue of nearly every Australian factory, so we would not be surprised to see our new circuit the basis of a new fashion in little sets. It's economy of parts and low cost means that it will give more useful work for the money than any little set we have designed to date.

We are quite sure you will get a shock at the performance of this newcomer to our circuit book. Do not regard it as "just another circuit." It is on the other hand a remarkable example of ingenuity and economy.

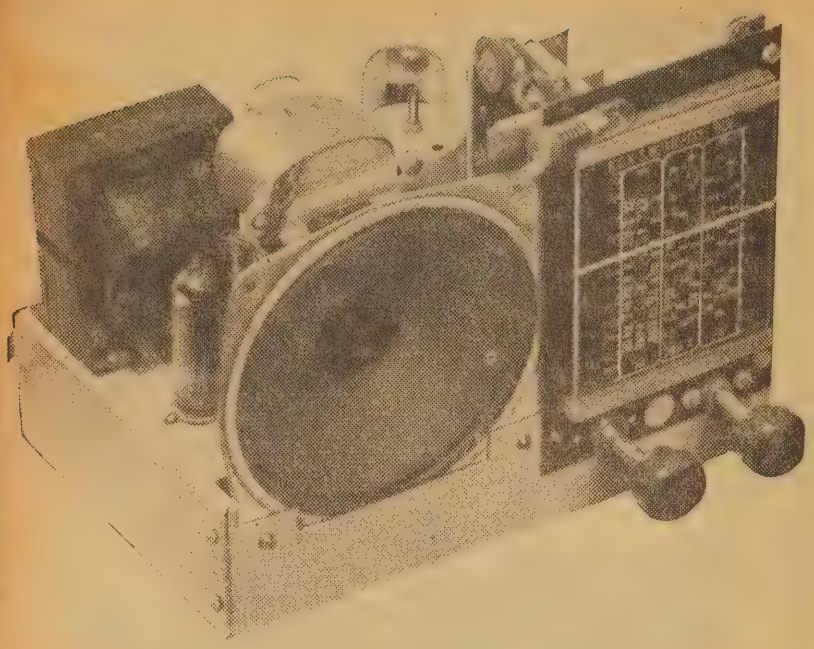
Those are fighting words for anyone to use about their own work. We wouldn't use them either, if we weren't so sure that the set definitely is news. All we hope is that you will make us prove them true by building up our new set for yourselves.

★ ★ ★

Fewer Colds

A REPORT from London says that British scientists have perfected a device which may greatly reduce the present loss of man-hours through common colds and like ailments.

Looking rather like a silver candlestick on a wall bracket, the device burns a pinkish-white powder called hexylresorcinol, a basic antiseptic used in many throat pastilles. The burning chemical gives off a colorless and odorless vapour which in tests has demonstrated its ability to reduce the germ population from 1,000,000 to less than 10 per cubic foot.



Here is the set constructed on the 1951 Little General chassis. No new holes are required. The valve to the left of the speaker is the 6X4 rectifier. Note the trimmer mounted at the top of each tuning gang section.

A NEW, SIMPLIFIED MANTEL SET

Here is yet another set to beat the rising prices. It is the smoothest, the most successful baby set we've yet described. You will be amazed at its performance. It plays all the locals at adequate volume for normal listening and will separate the stations as well as any large set.

by Raymond Howe

PROMPTED by the success of last month's "Junior Radiogram" we turned our thoughts to the mantel set field to see what could be done there without too much sacrifice in performance.

We wanted something which would play the local stations well, would separate them, irrespective of locality, and have a maximum of two valves plus rectifier. We have described small sets like this before, of course, but adequate selectivity under all conditions has been a problem.

Talking the matter over, a somewhat jocular remark, "How can we simplify the 'Little General'" produced a germ of an idea—and the idea came off!

Fundamentally, we wanted the selectivity of a superhet and the converter valve thus had to stay in as the first stage. How to obtain the benefits of a standard IF channel, detect the signal and provide audio output in one valve was the snag.

Well, we juggled ideas and circuits and finally came up with something that worked far better than all our expectations.

The answer was to use a medium-mu twin-triode with one half operating as a regenerative detector at the intermediate frequency and the other triode as the audio power output stage.

Some constructors may turn up their noses at the use of regeneration as something which is "finicky," detracting from smooth operation of the set. In this set, however, the regeneration achieves two objects without any of the usual disadvantages.

In the IF channel the regenerative detector operates at constant input frequency and, once the feedback trimmer has been set, it needs no further adjustment. It can be treated in the same way as the adjustments for initial alignment.

For two valves, plus a rectifier, the overall results are excellent. It handles like any other superhet and its output of 300 odd milliwatts is ample for the home. After all, most mantel sets are operated at actual output levels around 150 milliwats and output capabilities much beyond this mark are seldom called upon.

Its improved selectivity over comparable TRF sets has been well emphasised by actual test in various suburbs. In one particular location, where the masts of a good many of the local broadcast stations were, to speak colloquially, "within a stone's throw," the little set exhibited no difficulty in separating them all, in the same manner as any larger superhet.

The sensitivity, too, is such that, in locations well removed from the local stations, the volume control has to be backed off even with only a few feet of wire for an aerial. With a larger aerial, a little care in the circuit alignment and a more critical adjustment of the fixed IF regeneration trimmer, small country stations and some of the larger intersate stations can be played at good strength. We do no emphasise this point, however, as the set was designed primarily for local station use.

We have taken the opportunity of including this set in the Radio and Hobbies Kit series and accordingly have labelled it Kit No. 10. We intended doing that with the "Junior Radiogram" of last month's issue, but we must admit to an oversight there. However, we have labelled the "Junior Radiogram" the "R & H Kit No. 9."

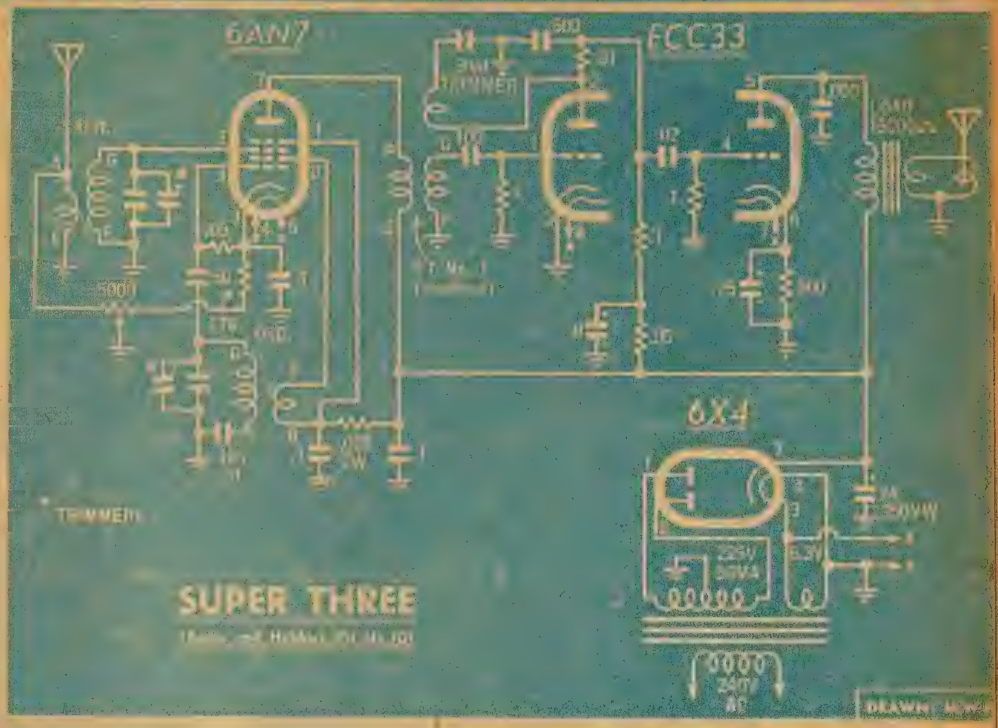
So much for the general outline. Let's treat the circuit in more detail.

As already mentioned, the first stage carries a converter valve. We used a 6AN7, being a well-known type, but the more recent 6AE8 valve could be substituted. Its conversion Gm is just a shade higher than the 6AN7, but the interesting feature is the zero-bias condition which would remove the necessity of using a bias-limiting resistor between the volume control and the cathode. However, the .1 mfd bypass would have to stay and the removal of one small resistor from the list of parts is but a small gain.

The octal-based valves, such as the X61M, ECH35, &c., could be likewise used with slight circuit amendment.

The stage operates in normal fash-

R. & H. BEATS RISING PRICES AGAIN



The general simplicity of the set is readily seen in this circuit diagram. The modification of the standard IF transformer is fully discussed in the text. Note that the amount of hum filtering in the power supply has been cut to a minimum to keep the overall cost down. If, in certain circumstances, further hum reduction is desired, the standard form of filtering used in large sets can be incorporated. The modified circuitry of the appropriate portion of the diagram is shown on page 33.

ion, with a common dropping resistor supplying the screen and the oscillator B-plus. The volume control operates in this stage by varying the bias at the cathode of the valve. To increase the effectiveness of the control, it is arranged to shunt progressively the aerial coil primary winding, as was done in the days of the old autodyne type receiver. The 175-ohm limiting resistor ensures the minimum operating bias for the valve.

AERIAL COIL

Apart from the valve type, the sensitivity of this stage will be influenced by the type of aerial coil used. The type having the windings encased in iron-dust cups will generally give more gain but, of course, are a little more expensive. In most circumstances, the uncased type will be satisfactory. Please yourself on this point.

The trimmer capacitors across the two tuning gang sections are used for the normal purpose of aligning the tuned circuits at the high frequency end of the tuning range.

For the next valve, we chose the ECC33 twin-triode. The 6SN7-GT could be used and, although the slightly higher gain of the ECC33 is observable in a laboratory, you may not notice much difference between them for ordinary listening. For the 6SN7-GT, the cathode bias resistor in the triode section feeding the speaker should go up to 1000 ohms.

We tried various methods of obtaining regeneration in the IF channel but we finally settled for a feedback winding of about 100 turns coupled to the grid winding of a No. 1 IF transformer.

To duplicate the scheme, remove the transformer from its can and identify the grid winding. The leads from it connects to the "G" and "F" pins at the base. In most transformers this winding will be at the top. Carefully unsolder these leads and lay them back out of the way.

Note the direction in which the grid winding is made and then jumble-wind the 100 turns for the feedback winding against the underside of this winding and in the same direction. If the grid winding happens to be at the bottom of the former, place the feedback winding against the uppermost side. In this particular case, you will need the carefully unsolder the leads of the other winding, the plate winding, so that the 100 turns can be wound on.

Hold the finished winding in place with a coating of coil dope or ordinary nail polish. Slip some small diameter spaghetti sleeving over the free ends of the winding and secure them in the two grooves at the side of the base moulding. Make sure that you leave sufficient free wire to make connections to the wiring of the set. Carefully resolder the leads of the disconnected winding back to their correct pins.

If the outer end of the grid winding connects to the "G" pin at the base, then the inner end of the new feedback winding should connect to the detector plate. If the inner end goes to the "G" pin the reverse holds true.

The gauge of wire for this feedback winding is not important, anything between about 32 and 38 gauge being OK.

We adopted this method of obtaining regeneration so that a cheap trimmer capacitor could be used for the feedback adjustment. Th other method of placing a sma choke in the cathode return ci cuit of the valve would normally ca for a more expensive item, a poter tiometer, to shunt the coil and s the degree of feedback.

Incidentally, regarding this latt method, we found that if a slug fro an old coil of IF transformer w arranged to mate with the cent hole of an LT RF choke (RCS ty RF 106), the inductance could adjusted to the exact value. Th overcomes the necessity of using potentiometer for the feedback cor trol.

RF FILTER

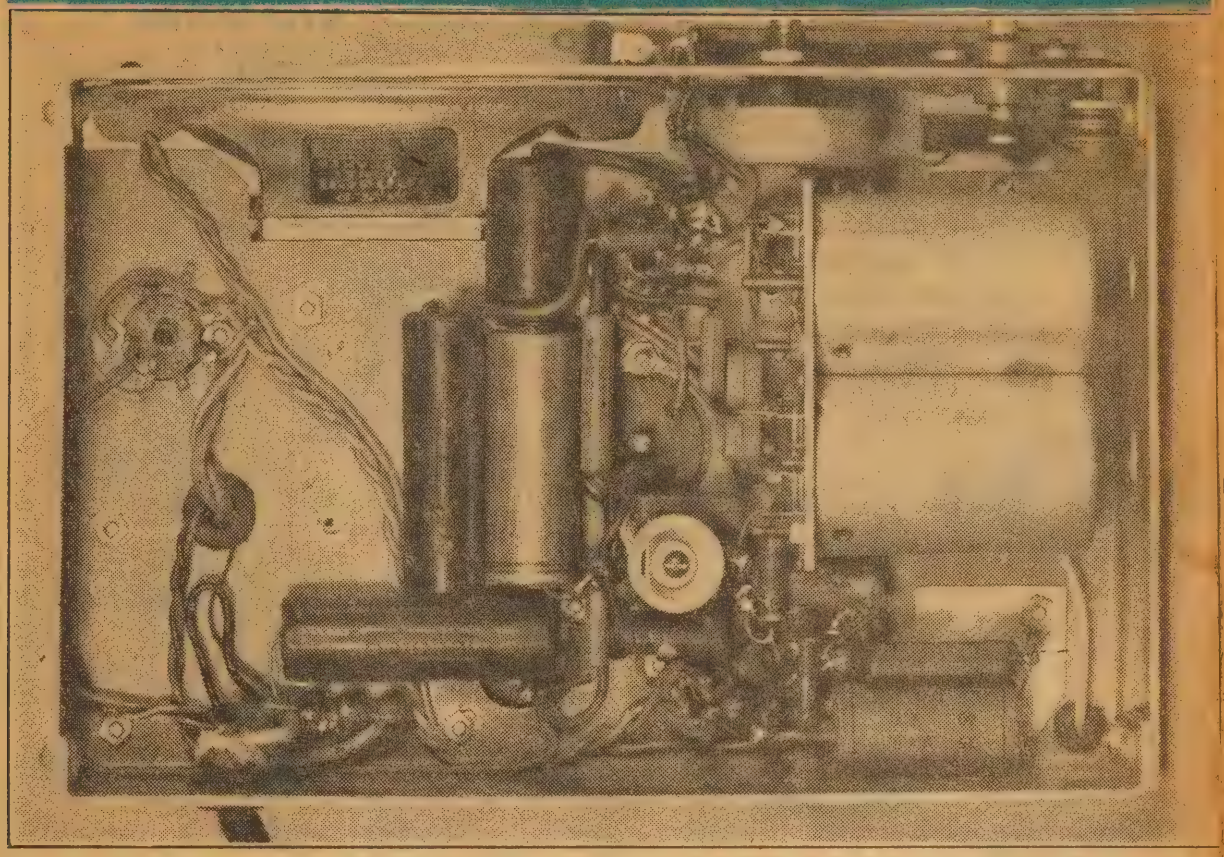
The .01 megohm resistor at th plate of the valve acts in conjun tion with the 500 pf capacitor form an RF filter and also to re moye the effect of shunt capac tance across the feedback winding.

The output of the detector is take to the grid of the other triode ha which drives the speaker. This sec tion functions a simple Class audio power stage, the optimum op erating bias being set by a cathod resistor. The .005 mfd capacitor en sures RF stability and also provide a desirable amount of "top cut."

The load impedance presented b the primary winding of the speake transformer should be as high a possible and the value of 15,000 ohm is about the highest which can b obtained through the normal chan nels. Of course, the set will stil work with one presenting about 500 ohms impedance, but the power out put is lower. The point is that th higher load impedance figure per mits somewhat higher audio pea output to be obtained.

WITH THIS AMAZING 3-VALVE SUPER

DETAILED UNDERNEATH PICTURE OF CHASSIS



With the aid of this photograph, you should have little difficulty in wiring the set. The grid resistor and capacitor of the regenerative detector are obscured by the feedback adjustment trimmer. The grid resistor for the power triode is mounted in the socket under the components at the right. The resistor near the IF transformer is one of two .05 meg. connected in parallel to feed the 6AN7.

One side of the voice coil winding is shown earthed to the chassis. This is not important, being suggested merely as a precautionary measure.

The transformer and rectifier combination in the power supply is the same as for the "1951 Little General." Although the current rating is more than adequate, we used this transformer because we wanted the advantage of the higher voltage. We obtained just on 280 volts.

While the outlay for a rectifier and a power transformer is just one of those unavoidable things, we went into the economics of the filter network. After all, the set is intended to be an economic as well as a practical success.

We managed to "get away with" a single 24 mfd electrolytic filter capacitor with the proviso that hum decoupling components were used in the plate feed to the detector plate circuit. Component for component, this is the cheapest form of hum filtering of the three possible methods.

As it stands, the hum level is sufficiently low as to be quite satisfactory under most listening conditions. If, when used under low-level listening conditions such as at a bedside, lower hum level is desired, there is room to fit a choke underneath the chassis. The choke plus an 8 mfd capacitor on each side will give all the hum reduction you could want. The decoupling components, the 8 mfd and the .05 megohm, in the detector plate circuit feed, can be omitted when the choke is used.

We have shown in a separate diagram the alterations in the wiring necessary for this to be done. Incidentally, because of the comparatively low current drain of the set, almost any high impedance inductor will do for the choke. For instance, the primary winding of an old speaker transformer would be quite OK.

Where you have a choke on hand or something which will serve instead, you may as well install the choke-capacitor filter in the first place.

When purchasing electrolytic capacitors for the HT filtering, bear in mind that those with the lower working-voltage rating are cheaper. A 350 volt rating is quite adequate for this set.

PARTS LIST

- 1 chassis 8½" x 5½" x 2¼" (1951 Little General).
- 1 cabinet to suit (Little General).
- 1 power transformer 225V a side 50 mA, 6.3V 2A.
- 1 miniature 2-section tuning gang (AWA).
- 1 dial with glass to suit gang (SLV 21).
- 1 aerial coil, 1 oscillator coil (suit 6AN7), broadcast.
- 1 standard No. 1 IF transformer.
- 1 5 inch speaker with 15,000 ohm transformer.
- 1 miniature 9-pin and 1 miniature 7-pin valve socket, 1 octal socket.
- 3 gang-section trimmer capacitors (50 pf).

VALVES

1 6AN7, 1 ECC33, 1 6X4.

CAPACITORS

1 25 mfd 40PV electrolytic, 1 24 mfd 350PV electro., 1 8 mfd 350PV (or higher) electro., 2 .1 mfd 400WV tubular, 1 .1 mfd 200WV, 1 .02 mfd, 1 .005 mfd, 1 500 pf, 1 425 pf (low tolerance), 1 100 pf, 1 50 pf.

RESISTORS

2 1 meg. ½w., 1 .1 meg. 1w., 1 .05 meg. ½ or 1w., 1 .025 meg. 2w. (or 2 .05 meg. 1w. in parallel), 1 .01 meg. ½ or 1w., 1 5000 ohm potentiometer, 1 500 ohm ½w., 1 175 ohm ½w.

SUNDRIES

2 knobs, 1 3-tag and 1 4-tag mounting strip, 3-core power flex and 3-pin power plug, 2 5/16" i.d. rubber grommets, 1 ⅛" i.d. rubber grommet, hook-up wire, spaghetti sleeving, nuts, bolts, solder, solder lugs, scrap aluminium for coil bracket and any cover plates.

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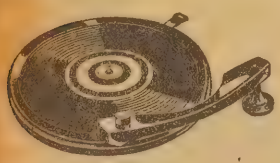

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Will fit any type turntable.
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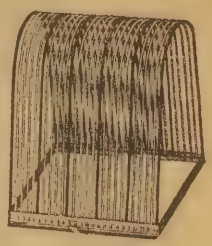

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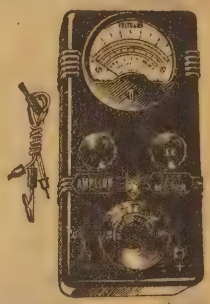

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Model 6H 6 inch Per. Mag. 55/9
Model 8K 8 inch Per. Mag. 64/4
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Model 12O 12in Per. Mag. £6/9/1

Also limited Number of 12OX's available, £8/19/2
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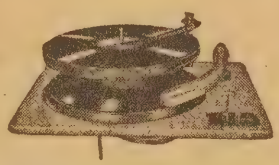

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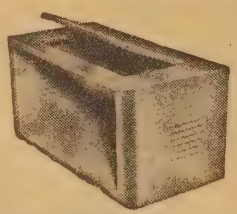

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Steel Cabinet finished in Grey Crackle finish.
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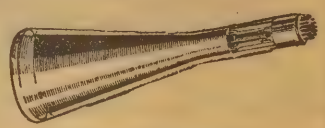

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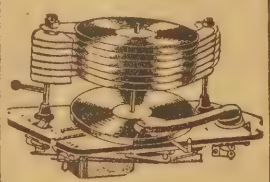

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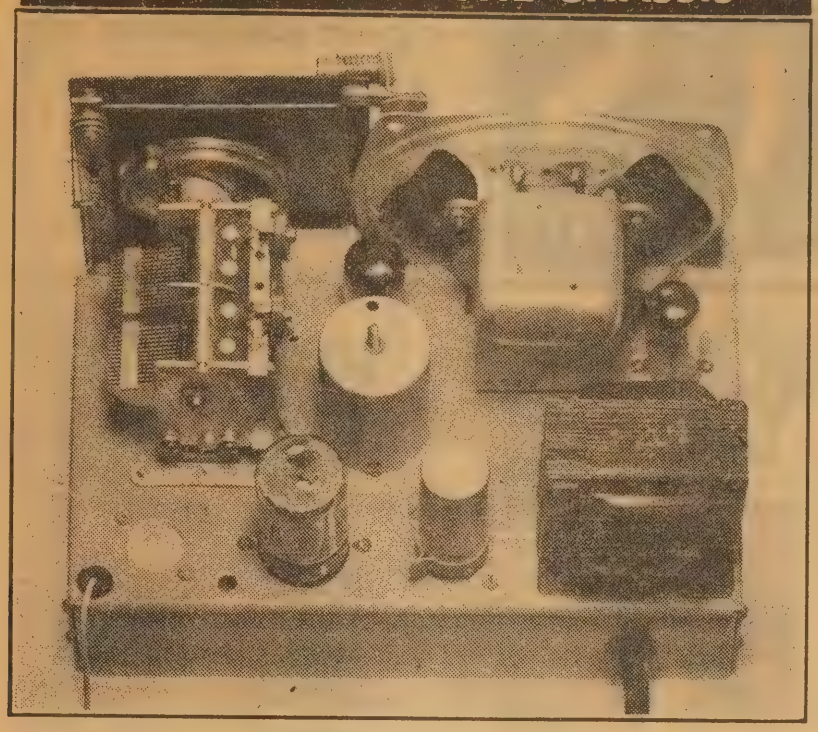
REAR VIEW OF THE CHASSIS

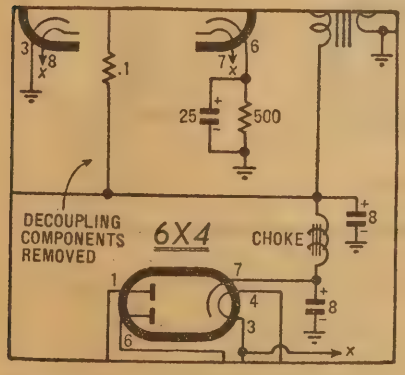


In this view you can see the ECC33 at the left toward the chassis rear, the 24 mfd filter capacitor to its right with the modified IF transformer and the 6AN7 toward the chassis front in that order. The aerial lead is brought out through a grummeted hole at the lower left corner.

Again from the viewpoint of keeping the overall cost down, we used a well-known mantel set chassis. It is the one used for the "1951 Little General." All versions of the Little General previous to the 1951 model used a chassis punched for the octal-based valves. Make sure that you get the one for the 1951 chassis, otherwise you will need to do some modification to it.

The various photographs show fairly clearly where the components fit. The unused valve socket hole can be left as it is or covered with a plate as we have done. The other unused valve socket hole carries the chassis-mounting can-type 24 mfd 350 working-volt electrolytic capacitor. If using a choke, you may be able to mount the can-type 350 volt 8 mfd capacitors in the unused valve holes.

We saved a few more pence by not using aerial and earth terminals. The aerial connects to a lead protruding from the chassis through a rubber-grommeted hole. The rubber grommet can even be left out, if you like. If a 3-core power cable is used, the chassis will be earthed via the earth system of the house wiring. Do this by connecting the red and black cores to the transformer primary winding and the green core to the set chassis. At the other end of the cable, connect the green core to the "earth" pin of the 3-pin flat power plug.



This partial re-draw of the circuit diagram indicates how to modify the wiring if you want to use a filter choke in the power supply for improved hum reduction. Note that the 8 mfd and the .05 meg. decoupling components can be omitted in this case.

VOLUME CONTROL

One thing to remember is that the volume control potentiometer must go into its position before the coil bracket is bolted down. Note that this coil bracket is held in place under two of the gang mounting bolts. The aerial coil is the one nearer the dial.

Mount the coils so that the connections of the "grid" pins are the shorter of the two possible arrangements. Mount the IF transformer also so that the leads to the appropriate valve sockets are the shortest.

The valve sockets should be mounted so that the gap between pins 1 and 9 of the 6AN7 socket is toward the speaker and the keyway of the ECC33 socket is toward the short axis of the chassis.

Place solder lugs under the mounting bolts of each socket other than the rectifier and one through a hole of the unused valve socket hole near

(Continued on Page 88)

1952 LIST OF RADIO COMPONENTS

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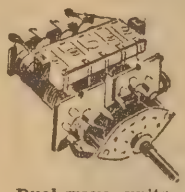
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Standard 455—K.C. Intermediate transformer.


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Filament transformer.


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Radio Frequency Choke.


Midget variable condenser.


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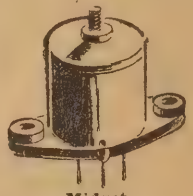
Audio transformer.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A COURSE IN TELEVISION

PART 36—PROBLEMS OF THE U.H.F. BAND

Very shorty, the FCC "freeze" on television expansion in the US will expire and decisions will have to be made about issuing station licences for the UHF band between 475 and 890 Mc. This article discusses the factors involved in an UHF television system.

THE inauguration of this service, with its many new technical and economical problems, is expected to have far-reaching effects on all phases of the video field.

Occupying, as it does, a portion of the radio spectrum where the methods of transmission and reception depart considerably from those practised in the present bands, this new frequency allocation will require the adoption of many new concepts and techniques in the development, manufacturing and servicing fields.

R.F. CIRCUITRY

Although the Federal Communications Commission proposes to maintain the presently used television engineering standards for band width, number of lines and frame repetition rate in at least the lower forty-two channels of the UHF group, the differences in propagation, antennas, transmission lines and r.f. circuitry make this band a radically new and interesting field of endeavor.

Necessity for additional television channels arises from the fact that several metropolitan areas have exhausted the VHF channel allocations that can be safely made for that locality without causing interference with stations operating on the same channel in neighboring areas.

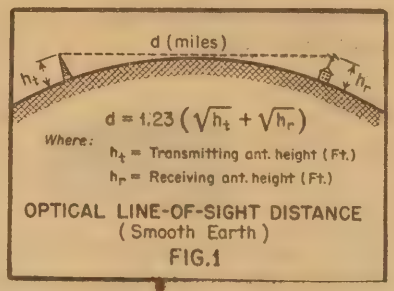
Such co-channel interference restricts the minimum spacing between stations sharing the same television channel to about 150-200 miles. Even with this spacing, viewers located between such stations are frequently bothered with "venetian blind" interference during periods of anomalous propagation.

Therefore, the FCC, with many more applications for television station construction permits on file than it had channels available, decided upon the UHF frequencies between 475 and 890 mc as the logical place to expand television broadcasting facilities.

H.F. PROPAGATION

One of the chief difficulties in TV broadcasting has been the unpredictable nature of short wave propagation. The common characteristic of such propagation is that, although the range of transmission under normal, undisturbed conditions is comparatively short, abnormal conditions which occur quite frequently, due to air mass movements in the troposphere, may extend the range many times.

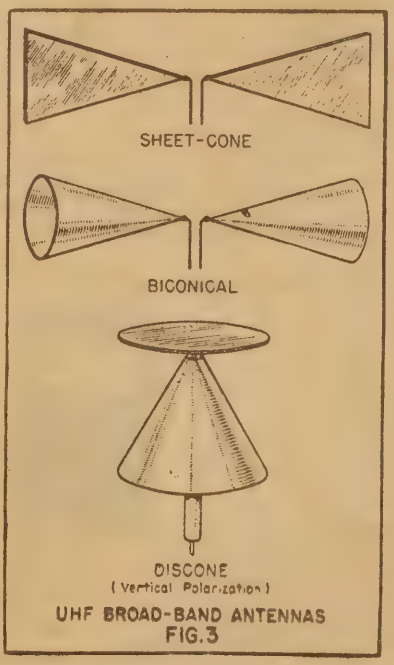
Thus, although it is necessary to use appreciable transmitter power to cover a reasonable primary service area, this power may frequently cause co-channel interference on receivers hundreds of miles away



OPTICAL LINE-OF-SIGHT DISTANCE
(Smooth Earth)
FIG.1

under conditions of abnormal atmospheric bending.

These effects bring about serious problems in station spacing and frequency allocations, and are considered important enough to warrant a brief discussion here.



UHF BROAD-BAND ANTENNAS
FIG.3

Radio waves in both the VHF a the UHF portions of the spectr normally follow line-of-sight la The relationship between transm ting and receiving antenna heig and station separation for a t optical path over the smooth eart surface is shown in Fig. 1.

Actually, because radio waves p pagating in an "undisturbed" eart atmosphere are bent or refract slightly so that they follow a pa which is theoretically four-thir of radius of the earth, the radio lin of-sight is about 15 pc greater th optical line-of-sight distance. T constant 1.23 in Fig. 1 may changed to 1.41 to include th effect.

Of course, departures from "smooth earth" and absorption scattering caused by large objec in the radio path modify the ran considerably. It is usually the rad line-of-sight condition which d termines the primary service area a television station.

AERIAL HEIGHT

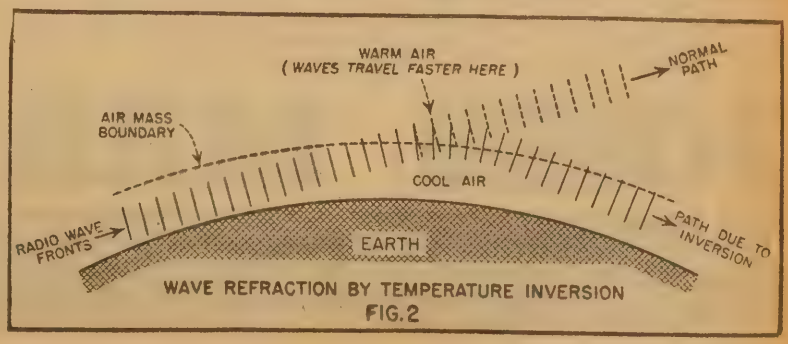
Beyond this radio horizon the si nal at ground level is attenuate rapidly with distance from the tran mitter and a satisfactory picture si nal can only be obtained by increas ing the antenna height, the tran mitter power or receiver sensitivit

This service zone in known a the "fringe area" and it is here th the effects of anomalous propaga tion are most pronounced.

Abnormal propagation of ver short radio waves is caused by sev eral sets of meteorological cond tions which may exist in the lowe several miles of the earth's atmos phere (the troposphere).

The most widely recognised c these conditions is that known a "temperature inversion." Such a inversion exists when the tempera ture decrease of the earth's atmos phere with altitude departs marked ly from the normal "lapse rate" o about 3 degrees F. per 1000 fee When this conditions occurs, bendin of radio waves in the lower atmos phere increases.

If the temperature of the air actu



WAVE REFRACTION BY TEMPERATURE INVERSION
FIG.2

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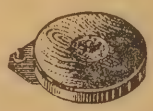

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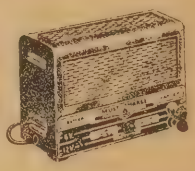

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ally increases with altitude, downward bending becomes very pronounced, resulting in reception of the waves far beyond the normal range. This bending is caused by the fact that the waves travel faster in the light, warm upper air than they do in the more dense, cooler lower air.

Therefore, radio waves passing obliquely from one medium to the other are bent downward, due to the optical phenomenon known as refraction. This process is illustrated in Fig. 2.

POWER REQUIRED

The basic differences between VHF and UHF propagation are that very much greater transmitter power is required in the UHF band to provide the same quality of television service that is presently offered in the VHF channels, although anomalous propagation effects will probably be worse.

Actual field tests of UHF television transmission made by responsible commercial investigators and by the FCC indicate that up to 100 times as much power may be required to provide UHF coverage comparable to that presently experienced in the lower bands.

Such power requirements are beyond the present status of the UHF transmitting tube art, although there is feverish activity in the industry to complete the development of suitable tubes.

The great emphasis on microwave tube development for military radar applications and the lack of commercial services in the 500-1000 Mc. region has resulted in this frequency range being somewhat neglected in the past.

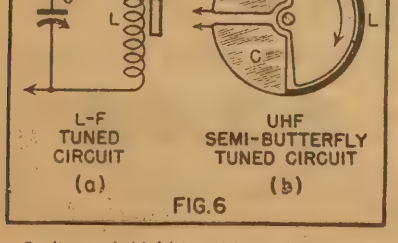
BANDWIDTH

The need for extremely high transmitter power for UHF television arises from the poorer performance of receiving components at these frequencies, in addition to the propagation limitations mentioned above.

The characteristics of receiving equipment for this band will now be discussed.

The problem of receiving antenna broad-banding is not as troublesome in the UHF television band as it has been at the lower frequencies. The frequency ratio involved is less than 2:1 in this case instead of the 4:1 frequency ratio which exists between the extremes of channels 2 and 13.

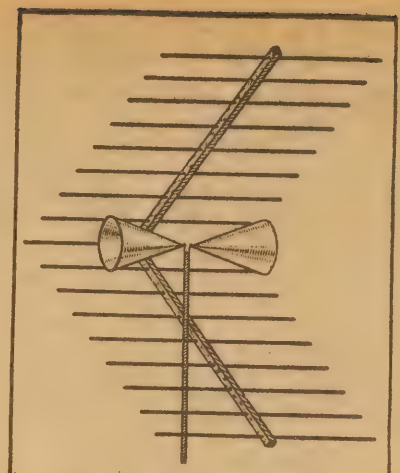
In addition, half-wave antennas in this band are quite small, ranging from about one foot in length at the low end to approximately six inches at the high frequency end. The small physical size makes it possible to use special broad-band designs which could not be employed at the lower television frequencies because of the prohibitive wind resistance.



L-F TUNED CIRCUIT (a)

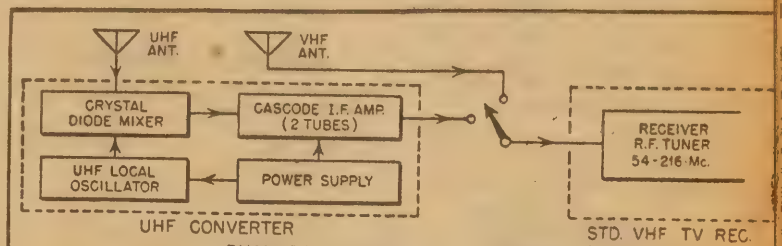
UHF SEMI-BUTTERFLY TUNED CIRCUIT (b)

FIG.6



UHF ANTENNA WITH SQUARE CORNER REFLECTOR

FIG.4



DUAL-CONVERSION UHF TV SYSTEM

FIG.5

Typical examples of such special UHF designs are the sheet-cone antenna, the biconical antenna, and the discone antenna depicted in Fig. 3. Antennas of these types can be effective over frequency ranges considerably greater than 2:1.

Balanced against the convenience of small physical size is the fact that a UHF antenna has a small "effective area," i.e., it extracts less energy from a passing wave. The effective area of an antenna is given by:

$$(1) \qquad \text{Area} = \frac{G\lambda^2}{4\pi}$$

Where: G is the power gain of the antenna, and λ is the resonant wavelength.

Since the effective area is proportional to the wavelength squared, an antenna resonant at 60 mc (5 metres) would intercept 100 times as much energy from a field of a given intensity as would an antenna of the same gain operating at 600 mc. (.5 metre).

It will therefore be necessary to employ antennas having high values of gain, since the effective area increases directly with gain.

For frequencies within the UHF TV band, relatively high gains are obtainable with special dipoles of the types shown in Fig. 3 when used in conjunction with cylindrical parabolic or square-corner reflectors.

An arrangement of this type is illustrated in Fig. 4. Reflectors of this kind are preferably constructed of metal spines or wire mesh to reduce wind loading. Power gains of over 16 db. are available in the UHF band with antennas of practical size.

Another serious problem in the reception of UHF television signals is the high attentuation in c mon transmission lines at ultra- frequencies.

The r.f. losses in the standard ohm ribbon-type lines make the of them prohibitive at UHF quencies. These losses are ma due to radiation from the line wl becomes much greater if an ap ciable standing wave exists. E high quality solid-dielectric coa lines such as RG-8/U exhibit tenuations which range from alr 6 db. per hundred feet at 500 mc nearly 10 db. at 1000 mc.

This means that only one-fo to one-tenth of the energy in cepted by the antenna would re the input of the receiver, if transmission line is 100 feet l Thus, the advantage of a high tenna to improve the signal stren is partially offset by the increa losses incurred by the long needed to feed the receiver.

This suggests that in some c it will be necessary to place UHF receiver front end at the tenna so that the lead-in works

the lower frequency of the i.f. wh the losses are much smaller. Li with low losses at UHF are ava able but are quite expensive.

One of the primary reasons maintaining the present black-ar white standards in the lower part the UHF band (channels 14 throu 55) is to make it possible to ada any of the several million existi low-band viewers to UHF by addition of a simple frequency cc verter.

Future television sets will u doubtedly have built-in UHF cov age but it is anticipated that dual-conversion system will used. This is because the UHF ba lies in the "awkward" transiti frequency range where lumpe constant circuits are unsuitable, a yet true distributed-constant circu such as cavities and lecher lines a quite bulky.

For this reason, combination VH UHF tuners appear impractical. addition, dual conversion has a vantages in image rejection, loc oscillator range, gain and flexibili

Fig. 5 shows, in block diagra form, the rudiments of the du conversion scheme. The incomi UHF television signal is heterodyn with the UHF local oscillator sign in a mixer of the vacuum tube crystal type.

The frequency of one of the VH television channels is chosen as t difference frequency, so that t output of the converter may be f

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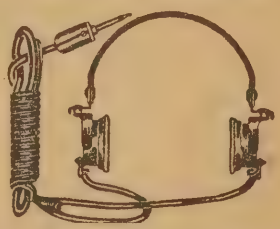

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into the input terminals of the standard receiver. The receiver r.f. stage acts as the first i.f. amplifier and the signal is again converted by the VHF mixer to the i.f. of the receiver.

The signal has thus undergone two frequency conversions before final detection.

Vacuum tubes of special design are required for r.f. applications at UHF because of the limitations of conventional designs.

Silicon crystals are favored for mixers at these frequencies because of better noise performance and greater simplicity. The noise figures of inexpensive r.f. amplifiers for UHF are so poor that most converter designs do not use r.f. stages ahead of the mixer, but may have a tune preselector or r.f. filter circuit to improve image rejection.

The r.f. circuitry used for UHF tuners represents a considerable departure from conventional low requency types although evolved directly from them.

Tuning circuits, in particular, present a new appearance at first glance. This is because a tuning range of nearly 2:1 is required to cover the tntire band, so that it is necessary to use combination inductive and capacitive tuning.

TUNING SYSTEMS

Special tuners which use this general principle are the butterfly, the semi-butterfly, and the split-cylinder types. The development of a UHF resonant circuit of the semi-butterfly type from the conventional coil-condenser parallel resonant circuit is illustrated in Fig. 6.

The frequency of the L-C combination (6a) can be varied either by changing the meshing of the condenser plates or by introducing a body into the coil which effects the permeability. If a brass "slug" is used, the frequency increases as it inserted into the centre of the coil.

In the UHF version (6b), the coil has become a single half-turn loop and the many condenser plates of the low frequency circuit have been reduced to two quarter-plates which form the stator plates of a spit-stator condenser. The rotor performs a double tuning action in this arrangement because it acts as a tuning "slug" in the position shown and increases the resonant frequency; then as it is rotated to mesh with the stator plates, it decreases the frequency.

The tuning range of this double-action type of tuning is greater than with either inductive or capacitive tuning used alone.

The conversion loss in a crystal mixer may be as much as 10 db. For this reason, it is usually necessary to add a stage of i.f. amplification to the UHF converter output to compensate for this loss.

The very popular cascode amplifier is widely preferred in this application because of its excellent noise figure of the i.f. amplifier used here is very important in establishing the overall noise performance of the receiver, since the preceding stages have little or no gain.

Noise figures of about 10 db. appear to be about the best that can be expected from commercially feasible UHF television converters.

—Aerovox Research Worker.

Here's your answer, Tom!

Perhaps you have a problem about elementary radio or electricity that has been worrying you. If you would like to put yourself in Tom's shoes, set your question or questions out on paper heading it "Here's Your Answer Tom," and address it to the Technical Editor, Radio and Hobbies, Box 2728C, GPO, Sydney. We won't publish your name but sign the letter as a mark of good faith.

IN the meantime, here is another list of queries in the tradition of our boy protege. Note that they go all the way from electric light to transmitting aerials.

What is AVC?

The letters AVC stand for "automatic control." The purpose of an AVC system to vary the amplification of the receiver so that the output tends to remain constant as the receiver is tuned to signals of different strengths.

In a particular location you may have a powerful station close at hand and a weaker station at a distance, both of which you are interested in receiving. The amount of energy reaching your aerial from the former may be many hundreds of times greater than from the latter so that, with a receiver having no AVC, it would be necessary to make a big adjustment to the volume control as you tune from one to the other.

If you tune from the weaker to the stronger without suitably adjusting the volume control the set is likely to just about jump off the table with disastrous results.

Most modern receivers are equipped with AVC so that, in changing from station to station, there is only a slight change in volume. It is actually possible to design a receiver so that very weak stations and very strong stations give the same volume but this is not always either desirable or practical. AVC is also very helpful when listening to distant and fading stations, since it avoids the need for continually readjusting the manual volume control.

In technical articles you sometimes refer to "gain" controls. Are these the same as volume controls?

In either case, Tom, the control mentioned varies the amplification factor or gain of the equipment in question but, in the case of a receiver, a variation in gain results in a variation in volume so that either description may be applied with equal justification. It sounds less pedantic to say volume control when talking about a receiver and you will notice that we mostly do this.

Communication receivers often have several controls which directly effect the volume and, as it would be confusing to label them all as volume controls, we usually distinguish them by RF gain, IF gain audio gain &c.

ON INSTRUMENTS

There are cases where it would be incorrect to talk about volume controls. A cathode-ray oscilloscope, for example, does not make audio sounds so that it is correct only to talk about its vertical gain control or horizontal gain control, as the case my be.

How does a mixer valve mix the signals and what is the reason for mixing the signals anyway?

We will take the second part of your question first, Tom.

Broadcast stations are spread over a frequency band between 550 and 1600 Kc. In order to select the particular station we require it is necessary to have a tuned circuit adjusted to that particular station.

At 550 Kc, it is easier to select the required narrow portion of the spectrum to the exclusion of all others than it is at 1600 Kc. If you have a tuned amplifier stage it is also easier to obtain high gain at the lower frequency.

Having observed these facts, some clever people worked out the idea of changing the signal frequency to a lower frequency where it is much easier to obtain the required gain and selectivity. Being intermediate between the frequency of the signal and the audio frequency which is eventually heard in the speaker, it is usually referred to as the "Intermediate Frequency," or "IF." The standard mostly adopted is 455 Kc, but other frequencies may be used if necessary.

Some means of changing the signal at the original frequency to a signal with the same characteristics at the IF is necessary. This is where the mixer comes in.

You have probably at some time observed two musical instruments playing the same tune at the same pitch. You have also probably noticed that when the two instruments hold the same note there is a periodic variation in intensity. If the two instruments are fairly accurately tuned the variation will be slow and only noticeable when the note is held for a long period of time. As the tuning becomes more inaccurate so does this variation in intensity become more rapid. If the two instruments are well off tune it will actually be heard as a separate note.

HOW MIXER WORKS

The mixer valve in a superheterodyne receiver works in much the same way. Two radio frequency signals are fed into it and a third signal which is at the difference frequency of the two original signals can be extracted.

If, for example, you wish to convert a signal at 1000 Kc to 455 Kc in order to realise the advantages of the lower frequency, you would feed the original 1000 Kc together with another signal at either 545 Kc or 1455 Kc into the mixer valve.

The signal at 455 Kc may then be fed into a tuned amplifier before being passed on to the detector. With special double tuned transformers the gain and selectivity that can be achieved in a given number of stages at 455 Kc is many times that which can be achieved at 1000 Kc.

With the intermediate frequency fixed, it is necessary to vary the frequency of the signal fed into the mixer from the local oscillator. If

the oscillator is tuned to 1455 Kc it would be possible for a signal at 1910 Kc to beat with it and produce the intermediate frequency as well as the desired signal at 1000 Kc.

To prevent this undesirable situation, a tuned circuit designed to accept the 1000 Kc signal but reject the 1910 Kc signal is placed ahead of the mixer. Usually it does not

contribute a great deal to the overall selectivity of the receiver, its main job being to select between the signal and the "image" frequency.

The tuned circuit, or circuits, between the aerial and the mixer valve are usually tuned by a condenser which is ganged to the condenser which tunes the aerial circuit so that it is only necessary to adjust one control to tune in a station.

Why is it necessary to have two electric light wires leading into a home? Does one wire carry the current while the other is an earth wire?

No, Tom, both wires are necessary to carry the current. If you wish to introduce an earth wire into the system a third wire is usually necessary.

CIRCUITS

You see, Tom, electricity travels in circuits and a complete circuit is necessary in order that current may flow. In the case of an electric lighting system installed in a home, we have a wire from one of the terminals of the generator at the power station connected to one of the terminals of the electric light globe in your home. From the other terminal of the electric light globe there is a wire going back to the remaining terminal of the generator.

If you like, you can imagine that the electrical circuit is like a length of water pipe bent around into a circle with the two ends joined. Into one part of the pipe we put a pump which makes the water flow around the circle. This corresponds to the generator.

Somewhere else in the pipe we can place a turbine so that the flow of the water causes it to turn. This corresponds with an electric motor, electric lamp &c in your home. Actually, what we have succeeded in doing is transferring the energy of the pump to another place with the aid of the water. In the same way, electricity is a convenient way of transferring energy from the power station to your home.

EFFECT OF SWITCH

You do not wish to have the electric light globe working all the time, of course, so you need a means of breaking the circuit. To do this you simply have a switch which breaks the metallic contact between the wires. In the mechanical analogy the corresponding device would be a tap to stop the flow of the water.

Your erroneous idea about the two wires in the house lighting system may have come from observing that tram and railway power systems use only one wire. The return circuit is not apparent as a wire but is made through the steel rails. In this case the system is automatically connected with ground. The earth could be used instead of a return wire in the case of electric light systems to save the expense of the second wire but there are special reasons why this is not done.

Instead, the earth wire is used to return the frame of appliances to "earth" so that the user is protected in the event of a fault developing.

With a resonant aerial as is used for transmitting does the feeder line have to be critical length?

It depends on the type of feeder, Tom. In the case of coaxial cable, 75, 150 or 300 ohm ribbon, the idea is to select a suitable point on the antenna into which to insert the feeder. The point is chosen to match the impedance of the feeder and for mechanical convenience.

Having correctly matched the aerial you can then extend the feeder as far as necessary. The length is not important, provided the feeder is correctly matched.

Sometimes, "tuned" feeders are used. In this case part of the aerial is doubled back on itself in such a way that no power is radiated by that part. In this case it is sometimes easier to cut the feeder so that it is an exact multiple of a quarter wavelength at the frequency of operation. Even so, if this is not convenient, the electrical length of the feeders can be adjusted by adding inductance at the transmitter end.

In general, no matter what type of feeder is used, it is good practice to make it as short and direct as possible and, if any modifications to its characteristics are required, these are made at the transmitter end.

Would you please explain what is meant by "bandspreading."

Perhaps the explanation would be more clear if we give you a concrete example, Tom.

You are probably familiar with the standard dual-wave receiver. The shortwave band usually covers fro 16 to 50 metres in one sweep of th dial. The 25 metre broadcast ban may occupy, say, ½" of the length the dial. In that ½" there may b dozens of stations in which you ar interested.

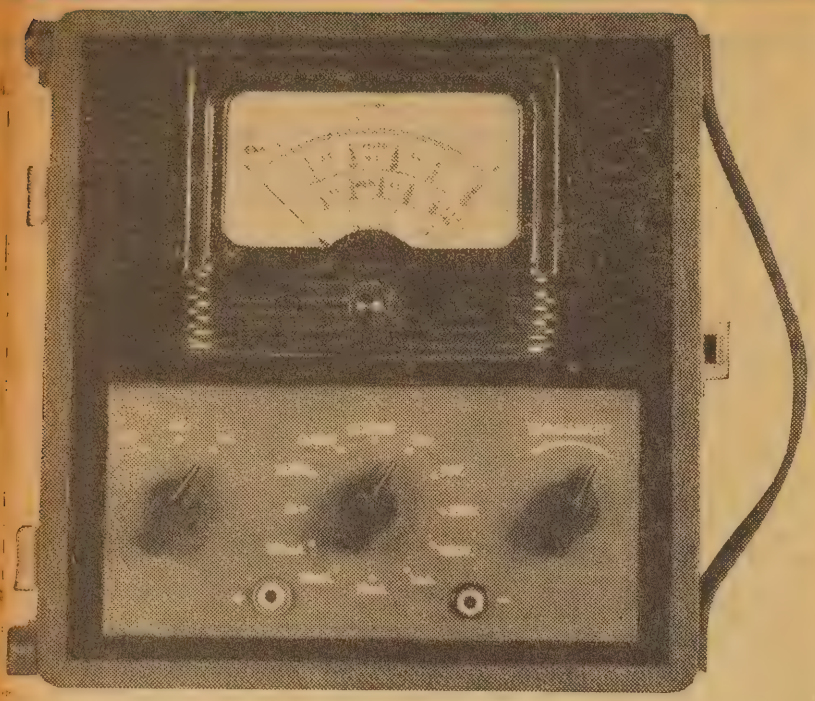
In order to tune them you have t be very careful and if the tuning kno happens to be bumped you are quit likely to lose the station altogeth and have some difficulty in finding again.

If, however, we arrange the tunin circuits so that the 25 metre ban occupies the whole of the dial, th stations can be made just as easy t tune as the stations on the broadcas band.

AMATEUR BANDS

Of course there are different de grees of bandspread. If you ar particularly interested in an amateu band, you can arrange the circuit so that a very narrow portion of th spectrum occupies the full band.

If you simply want to make tun ing a little easier you can arrang matters so that, say two of the short wave bands occupy the full dial. One commercial dual wave receiver w have seen has a special band which covers from 25 to 31 metres.



This is how your finished instrument will look when fitted into a standard carrying case. This, together with the printed label, helps to give a professional finish. Note the special hinges which enable the lid to be removed when the meter is used on the bench.

LEARN WHILE YOU BUILD

This month we come to the final stage in the construction of our multimeter—the addition of the AC ranges. As well as describing the actual wiring changes involved, we discuss the operation of the rectifier and its characteristics, with emphasis on the calibrations of the meter scale.

THE AC ranges of your multimeter will not be called upon quite as often as the DC ranges but they are, nevertheless, most valuable when they are required.

The main parts of a receiver where AC is to be found is around the power transformer, where the HT secondary and the filament voltages will, on occasions, need to be checked. Normally these may be taken as stated by the manufacturer but every so often one will strike something that is not quite correct and it can only be tracked down if one is equipped to measure AC volts.

TRANSFORMER PROBLEMS

Again, faults sometimes occur which could be due to transformer troubles, though not necessarily so and when this happens the only way to clear the transformer of suspicion is to measure its voltages. At the same time, the mains may need to be checked, for they are by no means infallible.

It is common practice these days to supply many types of transformers without terminal panels, the leads being simply color-coded and designed to be wired straight into the circuit. This scheme has a number of advantages and normally works out quite well, provided the color code is available but when a transformer is second hand, or the code is lost, there may be some difficulty in identifying the various leads, and in particular, the difference between the 5v and 6.3v windings.

When an AC meter is available it is only a matter of determining which is the primary winding (usually this is not difficult) and the identity of the remaining windings becomes a simple matter of measurement.

Another form of AC which needs to be measured is the signal voltage present in the plate circuit of the output valve and, when used for this purpose, the meter is referred to as an output meter. The purpose of this measurement is to determine when the best possible adjustment has been obtained in the various tuned circuits comprising the "front" end of the set.

This job is normally performed with the aid of a modulated oscillator which delivers a modulated RF signal to the aerial terminal of the set, the modulation, usually 400 cycles, being heard in the speaker. It is possible to judge the level of sound by ear but a much more accurate job can be done with a meter, hence provision for measuring these signals is included in most multimeters.

EFFECT OF AC

So much then for the general picture; now to get down to the "why" and "how."

As you have probably already found out, a moving coil meter needs to be connected into a circuit with due regard to polarity and, if it is connected the wrong way around, the meter will read backwards.

Now the AC we wish to read is constantly changing its polarity, at one moment being such as to move the pointer forward and the next moment wanting to move it in the opposite direction. The change occurs so rapidly (50 times a second on a normal mains circuit) that the pointer has hardly had time to commence moving in one direction before it is called upon to go the opposite way and the nett result is that it either does not move at all, or merely vibrates very slightly about the zero position.

This is where we call on the rectifier to come to our aid. You may remember we discussed the subject of rectifiers in the early part of this series (June, 1951) when we were concerned with the problem of converting the AC from the mains to DC suitable for use in the plate circuit of our receiver. On that occasion we made use of a valve type rectifier and, for that particular job, the valve has much to recommend it. It could also be used with our meter and, in fact, this was done in some older commercial instruments.

Main objection to this idea is that energy must be provided from some source to heat the valve filament and this generally means a connection to the mains as well as a transformer to produce the correct value. In the case of a set which has to be connected to the mains anyway this is no objection at all but it is hardly convenient if the AC section of the meter can only be used when there is a power point available to

by Philip Watson

operate it, while a transformer would add to the bulk, weight, and cost of the instrument.

This has led to the almost universal adoption, for this kind of work, of the copper oxide or "metal" rectifier. Actually there are other combinations of metals and oxides than copper, the selenium rectifier being one that is gaining in popularity at the present time. For the moment, however, we are mainly concerned with the copper oxide type since it is readily available and most of the meter manufacturers have designed their scales to suit its characteristics.

This type has the advantage of small size and weight (the instrument model is only as large as the top of your thumb and weighs but a few ounces), needs no filament or other energising power and, barring abuse, is practically everlasting. It has the disadvantage of being non-linear on low voltage ranges (more about this in a moment) but this is not serious at the voltages normally encountered in radio service work, providing the correct scale is fitted to the meter.

WHY IT WORKS

A metal rectifier "works" by virtue of the natural characteristic possessed by copper oxide when in contact with pure copper, namely, that of allowing electrons to flow much more readily from the metal to the oxide than they will from the oxide to the metal. Another way of looking at it is to visualise the combination as having a very much higher impedance to electron flow in one direction than in the other.

In practice these rectifiers are made up of several discs held together with a central bolt and arranged so that they are connected in series, in parallel, in series-parallel or bridge circuits as required. Where large amounts of power are being handled, cooling fins are assembled with the discs but, for the instrument type, the amount of heat generated is negligible and they are usually mounted in a small moulded bakelite case.

The circuit diagram showing altered and additional wiring. Note the switch contact and section numbers which should be referred to the wiring diagram on page 47. It may also help to consult last month's circuit so that the changes may be better appreciated.

A single rectifier element, if large enough, could be connected in series with a meter movement as shown in figure 1 and would provide an AC meter of sorts since the major movement of electrons would only occur in the direction of the arrow. When the polarity is reversed the rectifier would allow only a small flow in the opposite direction. However, such an arrangement would not be very efficient, an AC voltage producing a very much smaller deflection of the pointer than would an equivalent DC voltage.

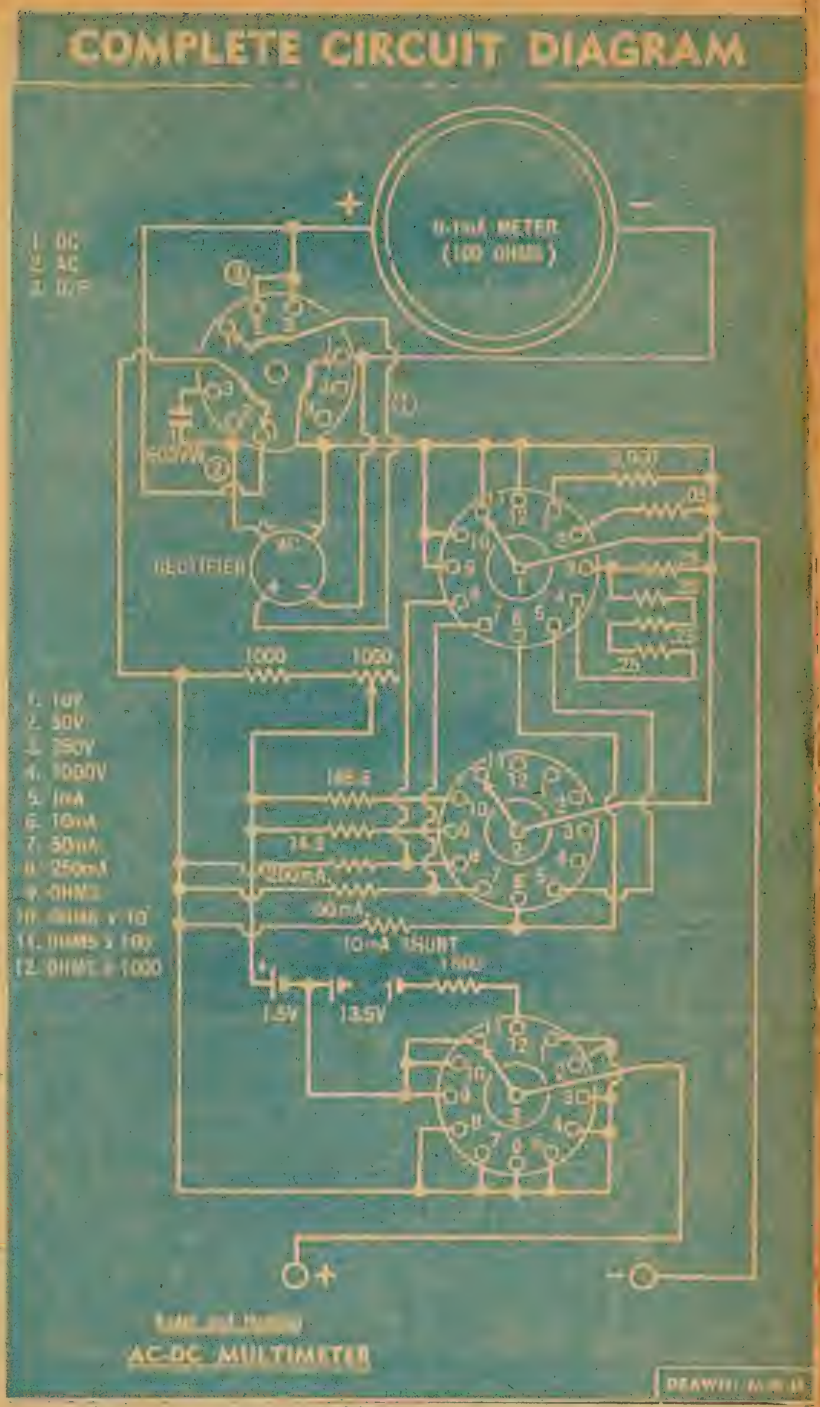
Much greater efficiency is obtained if we can provide full-wave rectification, that is, some means by which both halves of the AC wave can be made to pass through the meter in the same direction. You may remember we did something like this in the rectifier section of our receiver only, in that case, things were made easier by the use of a centre-tapped transformer.

Since the source of voltage to be measured does not provide this facility we must investigate other ways and means of achieving full-wave rectification, and this brings us to a consideration of the bridge circuit. An example is shown in figure 2a and it will be seen that a total of four rectifiers are required for this arrangement.

The operation of the bridge circuit is not difficult to follow if we break the process down into a few simple steps. This has been done in figures 2b and 2c where the electron path is shown for both halves of the AC wave. In figure 2b it is assumed that the upper input terminal is negative so that the electron flow is through rectifier No. 1, then the meter (from left to right), and finally rectifier No. 4 back to the positive terminal. No electrons can flow through rectifiers 2 or 3 because their natural conductivity is in the opposite direction.

When the polarity reverses (figure 2c) and the lower terminal is negative, the path is through rectifier No. 3 then the meter (again from left to right, which is the most important point of the whole business), and finally rectifier No. 2 back to the positive terminal. During this half of the cycle, rectifiers 1 and 4 are idle due to opposite conductivity.

Thus it is that the current is caused to flow through the meter



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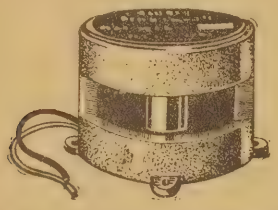

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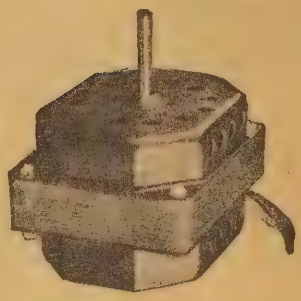

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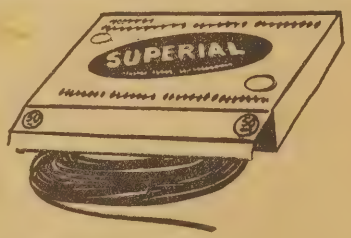

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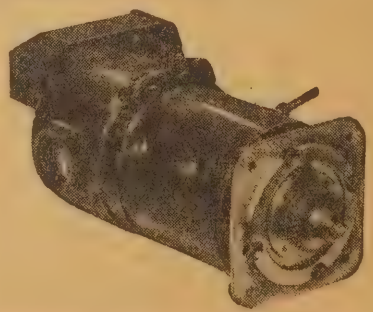

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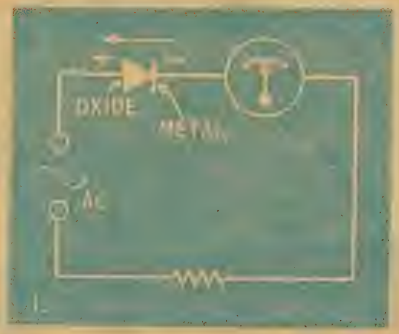
DIAGRAMS EXPLAIN HOW RECTIFIER OPERATES

Figure 2a is the conventional schematic circuit for a bridge rectifier, while figures 2b and 2c show the electron path for both halves of the AC wave. The dotted sections show the rectifiers which are not conducting in each instance, the electron flow being through the solid sections.

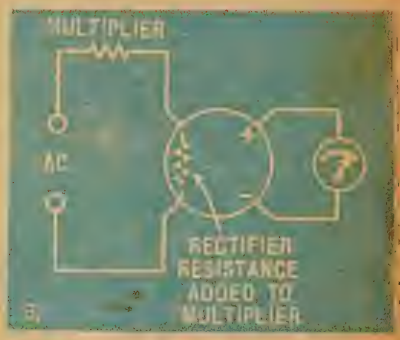
always in the same direction, regardless of its direction in the external circuit, and both halves of the wave are used.

This results in a deflection of the pointer very nearly, but not quite, equal to that for the same value of DC voltage. Before we can proceed further we will have to introduce such terms as RMS, peak, and average values as met with in discussions on AC.

Providing we consider only a pure sine wave the relation between these three values can be given definite numerical values. As far as the ability of current to do work is concerned, the peak value is of little use for it is only present for a brief instant of time. To present a value which will represent the ability to do the same amount of work as an equivalent value of DC we use the term RMS. The letters stand for Root-Mean-Square, but you need not delve too deeply into the origin of those words at this stage.



A simple AC meter can be made with a single rectifier element but the efficiency of such an arrangement is low and the meter deflection will be less than half that for an equivalent value of DC.



Showing how the resistance of the rectifier is added to the existing multiplier resistance. The actual value varies with the amount of current through the rectifier, increasing for low values, and leads to non-linear scales on the lower ranges.

COMPARATIVE VALUES

Sufficient to say the RMS value may be found by multiplying the peak value of .707 or the RMS may be converted to peak value by multiplying by 1.4142. These figures apply only in the case of a pure sine wave but are sufficiently accurate for use with most wave forms unless they are grossly distorted.

nI practical radio work most of the wave forms to be measured are essentially of sign wave formation and the few pc of distortion, undesirable though it may be for other reasons, is not of much consequence as far as the meter is concerned. Thus we may calibrate our scale on the assumption of a sine wave without serious error.

Another value, which is of particular interest to us at the moment, is the average value. This is lower still than the RMS value, being only .637 times the peak value, which also happens to work out to .9 of the RMS value. The reason we are so interested in this value is because it is that which the rectifier delivers and it is necessary to consider how this affects the calibration of the scale.

If the rectifier were a little more obliging and delivered a value equal to the RMS value of the current passing through it, we could use the existing DC scale of the meter for most ranges. Unfortunately, it doesn't, 1 mA AC RMS fed into the AC side of the rectifier delivering .9mA DC to the meter, a value equal the average value.

The average value is not a great deal of use in practical working, the RMS value being the most popular. To obtain this value we could take a reading from the DC scale and multiply it by 1.11, but such a procedure would obviously be inconvenient and time consuming, so it is common practice to provide separate scales for the AC ranges, correcting them from the average to the RMS values.

Since the average value equals .9 times the RMS the end of the new scales will fall opposite the .9 mA marking on the DC scale. (You can check this by using the ohmmeter circuit to set the pointer to this value.)

No doubt by this time you are itching to ask, "What about the 10-volt scale?" for it is obvious that it is not covered by the above explanation. This brings us to the

PARTS LIST

1 0-1 mA meter, 100 ohms internal resistance, universal scale S4-46A or similar, non-steel calibration.
1 3 Bank, 12 position switch with shorting type contacts.
6" of resistor strip having twelve contacts on each side.
1 Bakelite panel 8" x 7½" x ¼"
1 1000 ohm potentiometer.
1 1000 ohm 1 watt resistor 10%
1 13,500 ohm 1 watt resister 10%
1 14.8 ohm shunt.
1 166.6 ohm shunt.
1 950 type cell.
1 703 type battery.
1 Pair test leads.
2 Tip jack sockets.
3 Pointer knobs.
1 50,000 ohm 1 watt carbon resistor 1%
1 9900 ohm 1 watt carbon resistor 1%
4 250,000 ohm 1 watt carbon resistors 1%
1 10mA shunt.
1 50mA shunt.
1 250 mA shunt.
All matched for 100 ohm-1 mA meter, Solder lugs, hook-up wire, nuts and bolts, etc.

Additional Parts for AC Ranges

1 Copper oxide rectifier, type MBS1 or MBS5.
1 3-position, 3-pole switch.
1 .1 mfd. 600-volt condenser.
1 Pointer knob.
Bakelite or aluminium for rectifier bracket, insulating tubing, etc.

consideration of another rectifier characteristic; its resistance on the AC side.

An examination of figure 3 will show that this resistance is effectively in series with the multiplying resistor, making the full scale deflection voltage higher than that indicated by the value of the multiplier alone. Thus, when using the same multiplier as for the DC range, the scale will be made shorter still.

And why does this effect only show up on the 10-volt range?

Because the amount of resistance, about 500 ohms for the type of rectifier we are considering, is small relative to the multiplier for the 50-volt range, or higher, and the error introduced is only 1 pc or less. For the 10-volt range, and lower ones if any, this amount becomes increasingly important and the scale must be adjusted to avoid serious error.

SPECIAL SCALES

Actually, for maximum accuracy, the scale should be calibrated for each individual rectifier, since there are limations to the tolerances which can be maintained in the manufacture of these units. These are such that most commercial instruments are regarded as acceptable if within plus or minus 5 pc on the AC ranges, a figure which works out quite satisfactorily in practice.

Another point which you will notice about the 10-volt range, if you look carefully, is that it is non-linear. This simply means that the distance between the zero and 2-volt divisions is different (less in this case) from that between the 8 and 10-volt divisions and is due to the rectifier resistance, which we referred to above, varying with the amount of current through the rectifier.

As the current decreases, the resistance of the rectifier increases, adding still further to the total multiplier resistance and tending to crowd the divisions at the low end of the scale. This is evident mainly on the 10-volt range only, for exactly the same reason that the 10-volt range is shorter than the others, i.e., the amount of rectifier resistance is so small relative to the higher multipliers that neither its presence nor its variations will be noticeable.

There are several other ways of overcoming these unfavorable rectifier characteristics and most of them aim at using the original DC scales rather than providing separate AC scales except, perhaps, where it is necessary to accommodate the non-linearity of the lower ranges.

One way of doing this is to provide a basic meter movement of .9 mA rather than 1 mA. This is then shunted to 1 mA for the DC ranges, but the AC selector switch is arranged to remove the shunt when the rectifier is brought into circuit. Thus both AC and DC voltages may be read on the same ranges, at least for the AC ranges of 50 and up, a feature which does provide some convenience in reading the scales.

Not very much can be done to eliminate the non-linear effects on the lower ranges but the effect of rectifier resistance can be overcome and the lower ranges made to have the same full scale position as the others. This is done by reducing the multiplier value by the amount of the rectifier resistance then adding this amount to the circuit for DC readings but removing it when the rectifier is brought into circuit.

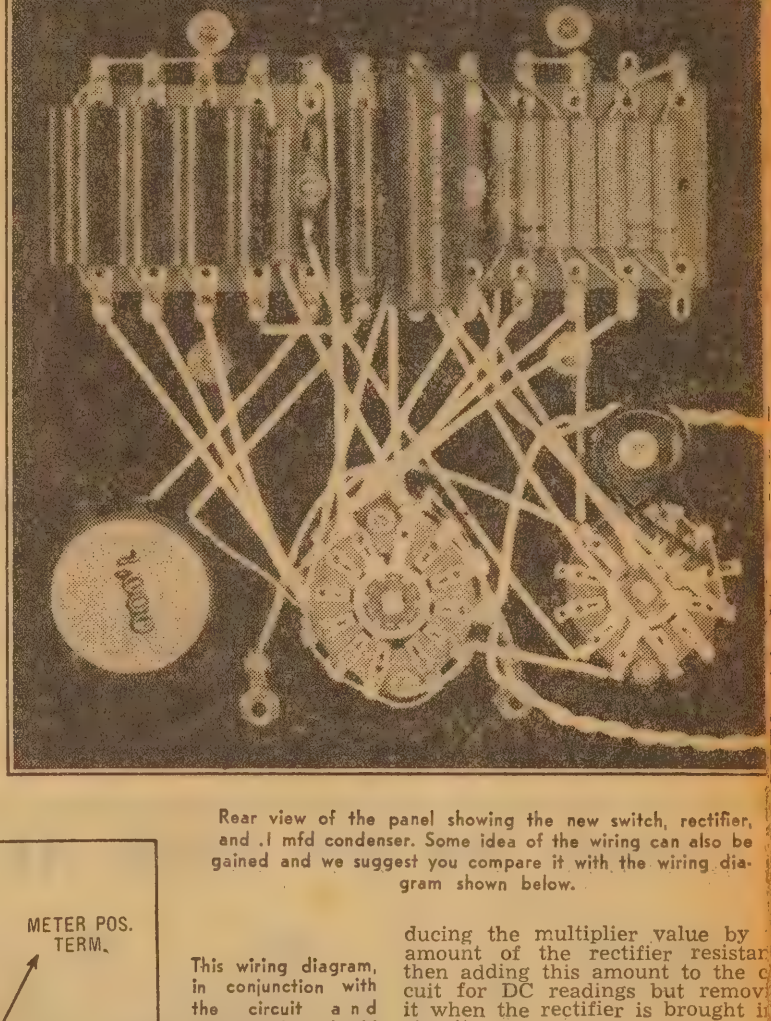
Quite naturally, all these additions to a basic circuit make for considerable complexity, to say nothing of the increased cost, and are hardly justified except in special cases. The approach of designing a set of scales to suit the rectifier characteristics is completely justified on economic grounds.

SEPARATING AC FROM DC

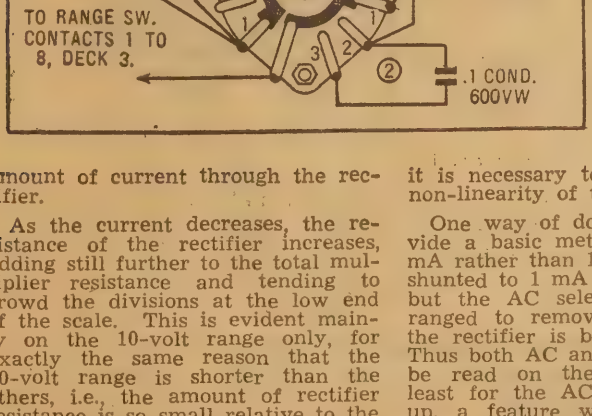
Finally we come to the output meter section. Since output measurements are normally made at the plate circuit of the output valve, it is necessary to provide some means of separating the DC voltage, which does not interest us at this stage, from the AC signal voltage, and it is the job of the .1 mfd condenser to do this. This is really the only change from the straight AC connection, namely, the inclusion of the condenser in series with one lead to the rectifier on the AC side.

The effect of the condenser, apart from eliminating the flow of DC is to increase the total impedance of the multiplier circuit according to the condenser's impedance at the frequency involved. At 50 or even 400 cycles the impedance is high enough to seriously affect the ac-

A REAR VIEW OF THE METER

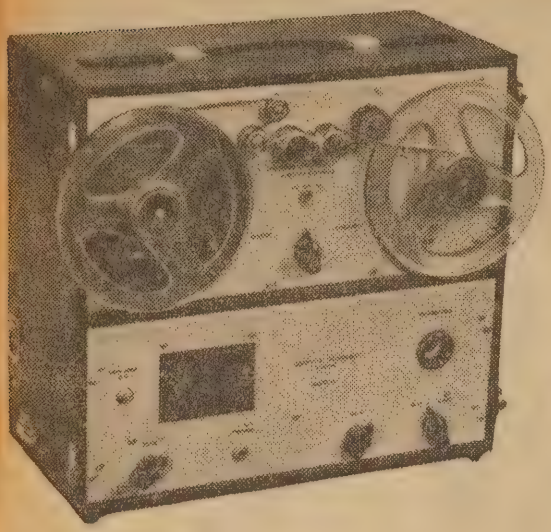


Rear view of the panel showing the new switch, rectifier, and .1 mfd condenser. Some idea of the wiring can also be gained and we suggest you compare it with the wiring diagram shown below.



This wiring diagram, in conjunction with the circuit and photograph, should make the additional wiring easy. It is a good idea to wire the switch and rectifier first, then connect it into the main circuit.

UTILITY THE KEYNOTE



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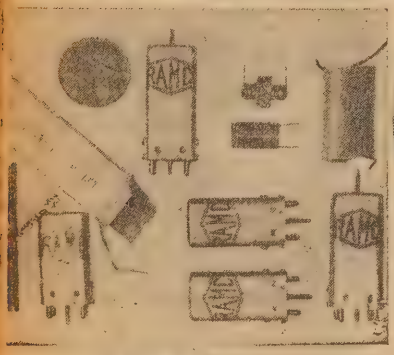

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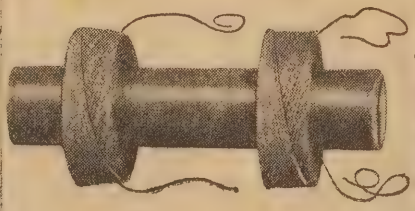

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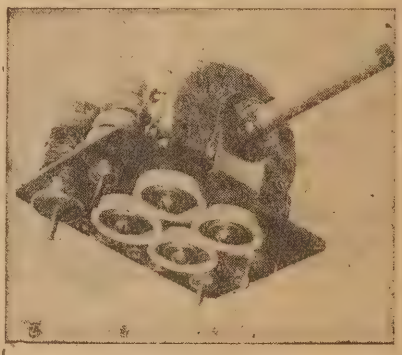

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curacy of the instrument as a voltmeter, but this is not important, since the main requirement is simply a means of indicating relative output strengths.

Coming now to the more practical side, we may consider the type of rectifier commercially available and how this is to be incorporated into our multimeter. The copper oxide types, having a rating of 1 mA or 5 mA, are suitable for use with the meter scale specified and are known as types MBS1 and MBS5 respectively. Units with higher ratings than this, such as the MBS10 or various types of disposals rectifiers, will have characteristics unsuited to this scale and should not be used.

BRIDGE CONNECTIONS

The rectifier, as supplied, is already connected in the required manner for a bridge circuit and four leads only are provided. These are the two AC leads, generally colored white, and the positive and negative leads to connect to the meter. These are usually colored red and black respectively, while terminal markings are also moulded into the bakelite case. No attempt should be made to dismantle the unit, for this will almost certainly result in its being completely ruined.

In addition to the rectifier, you will require 3-pole 3-position switch, a .1 mfd 600-volt paper condenser, an extra pointer knob and a small piece of bakelite or aluminium to make a support for the rectifier. The rectifier is normally supplied with a mounting screw and it is advisable to make sure on this point as it is a B.A. thread not likely to be available in your junk box.

We mounted the rectifier on a small piece of thin bakelite, one end of which was secured under one of the assembly nuts on the switch. An alternative arrangement is a small aluminium bracket which can be mounted under one of the meter mounting screws, but you can select whichever arrangement is most convenient.

When wiring the rectifier to the switch it is important to avoid overheating the unit when soldering to the leads For this reason, the makers recommend that the leads be left at approximately their original length, and any surplus length simply wrapped around the rectifier. Naturally, they will require to be protected with insulating tubing.

CHANGING THE WIRING

With the assembly complete you can commence the wiring alterations. You will probably find this job a little more complicated than the previous ones, though it is still not to be compared with the wiring of a complete set. To assist you in the task, we have prepared a sketch of the switch showing the rectifier connections and the various leads which connect to other parts of the circuit.

Since the DC circuit, which was originally wired direct to the meter now has to go through the switch, there will be a number of alterations to the circuit, rather than mere additions, as has been the case up till now. To get a better idea of the changes involved, we suggest that you compare the present circuit with that published last month.

Best approach would appear to be to connect the rectifier to the various switch connections, as shown in the sketch, and then make the following alterations to the existing wiring: First, disconnect all leads to the meter negative terminal, junction them at the most convenient point, and then connect this junction to the moving contact in section 1 of the switch. Now connect the meter negative terminal to contact 1, section 1.

Treat the leads to the meter positive terminal in the same way, taking the junction to the moving contact of section 2. Contact 1 of section 2 then goes to the meter positive terminal.

The final stage is to mount the .1 condenser on the two remaining lugs on the terminal panel (near the centre), and connect them to contacts 2 and 3 of section 2.

With all the wiring complete, check it over carefully, and then look around for a source of AC to test it. Any receiver will do, and the 6.3-volt filament wiring is about the best for a start. If all appears well, you can switch to a higher range and measure the HT secondary voltage on each side of the centre tap. The mains voltage can also be checked, but keep your fingers clear when probing for these connections. Also be careful that they are not shorted to the chassis with the prod, or you'll have a blown fuse to replace.

OUTPUT POSITION

You can also switch to the O/P position and check this section by connecting one lead to the plate pin of the output valve and the other to chassis. With a station tuned in, you will find the meter will wander up and down the scale in sympathy with the audio signals.

It is as well to start with the main switch set to the 1000-volt range, and then come down the scale as you get the feel of the sensitivity. It is very easy to overload the meter when using it in this way, and it is advisable to leave plenty of margin for a sudden loud signal which may send the needle hard over to full scale. Tuning over the band with the meter in a sensitive condition is simply asking for trouble.

Final stage of the construction is to fit the panel into a suitable carrying case and make arrangements to mount the batteries. We used a case originally designed for the Radio and Hobbies Standard Multimeter and which is quite suitable since both panels are the same size.

There is plenty of room for the batteries and you may work out any convenient scheme to hold them in

(Continued on Page 109)

AUSTRALIA'S FINEST SELECTION OF

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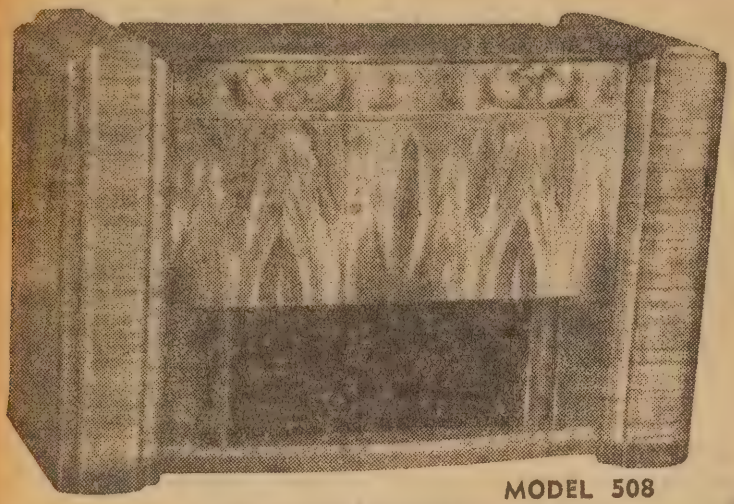

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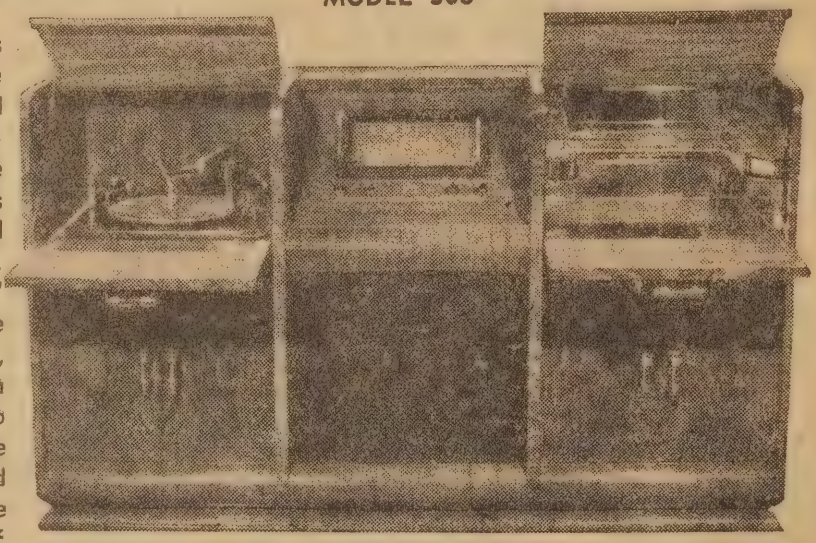

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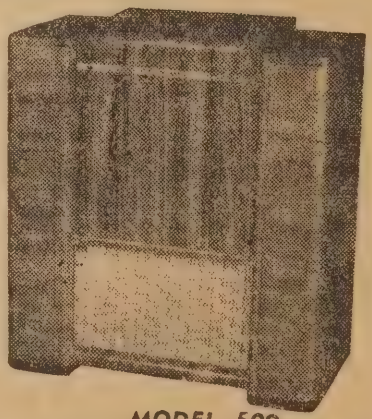

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FROM THE SERVICEMAN WHO TELLS

This month I have elected to deal with two pieces of test equipment since one, at least, is almost useless without its companion. Although hardly in the essential class they are extremely valuable for those who combine some design work with their routine servicing. The service case details another battle of wits with an intermittent.

THERE is no doubt that the cathode ray oscilloscope, or "crow" as it is popularly called, is one of the most useful devices which the design engineer has at his disposal, but it must be realised that this fact alone is not sufficient to justify its place on the serviceman's bench.

The fact is that this instrument, when considered from the angle of straight-out routine servicing, is very much over-rated and, when the matter is viewed objectively, there is usually some difficulty in justifying its existence on this score alone.

Now don't get me wrong. I have no opposition to this instrument, but I do want to locate it in its correct place in the scheme of things. I make this point because there are many beginners who imagine that it should follow almost as a matter of course after the multimeter and modulated oscillator and, further, that it will replace many of the more conventional instruments in one swoop.

DESIGN INSTRUMENT

Actually nothing could be further from the real facts. Fundamentally, the CRO is a design engineer's instrument and can normally only be justified on the serviceman's bench if he intends to do a certain amount of design work, either as a sideline to the main business or simply as a hobby. (After all, a fellow needs something to take his mind off the job at the weekend!)

If the instrument can be justified on this score it can be regarded as fortunate when, on odd occasions, it is of use for routine servicing, but these occasions are normally so rare that, alone, they would never justify the expense of the instrument.

This is particularly so when it is realised that the CRO by itself is practically useless and that some form of variable audio oscillator, with a high quality performance, is just as essential and, in fact, the two must be regarded as inseparable. Thus the cost of installing a CRO does not stop with purchase price of the instrument itself.

Summing up then one may say that the CRO is about the last instrument which the serviceman should consider, and then only if there is some other justification for its use.

And having told you why you should not buy one I will now proceed to detail what can be done with it, and what can be regarded as desirable or not in its features.

The main function of the instrument is to observe the wave form of AC signals so that the overall distortion of a unit can be checked by feeding a pure signal into it and observing the shape of the output wave.

This will call for some experience and knowledge of wave forms, but the job is not particularly difficult if the original wave form is substantially pure.

Trying to judge how much distortion has been added to a signal which already contains several pc of various harmonics is quite another matter, and one is hardly in the race to make an accurate estimate. All which simply emphasises that your audio generator needs to be a good one and, if you buy it ready made it can set you back quite a substantial amount.

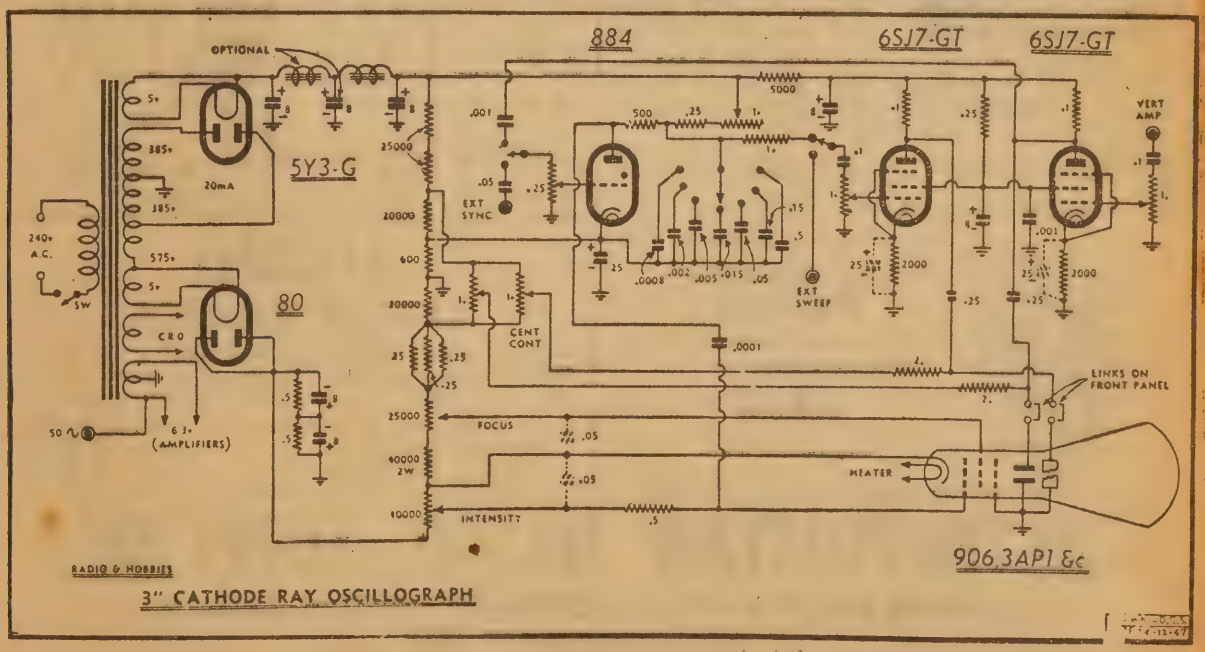
TRACING DISTORTION

When an otherwise well-behaved set decides to give forth distorted sounds the CRO can be used to trace down the offending stage by observing the wave form at various points in the circuit, a pure sine wave being fed into the input terminals. Once the offending stage is located the multimeter may be used to find the faulty component.

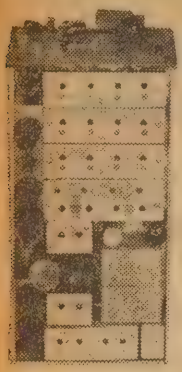
In practice the audio section of an ordinary receiver is relatively simple and most servicemen find it just as easy to check the few components involved in the complete section, giving priority to such "regulars" as open screen resistors and leaky coupling condensers.

Supersonic oscillation is another defect which is readily determined by the CRO, although it can usually be detected with an output meter or better still, a VTVM.

One exception to this is a form



This circuit is typical of the simple but effective CRO which can be built around a 3" tube. The really special part, apart from the tube itself, is the power transformer which has an additional winding for the HT supply.



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4 BAND 195 KC TO 9050 KC CONTINUOUS COVERAGE

£19-15-0 FREIGHT EXTRA

These receivers are designed for 24V D.C. operation but can be converted to operate from 12V or 32V D.C. or 240V A.C. with external power supply.

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Ideal for car or boat installation. Dimensions 8½" x 7" x 16" deep.

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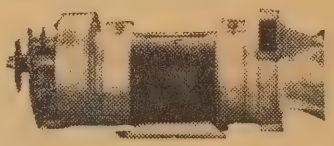

TYPE "B"

These motors are rated at 18 volts D.C. and develop 1/10th. H. P. but will operate on as low as 6 volts. Easily converted to operate on 240V A.C. as per R. & H. December, '49, or Hobbies Illustrated November, '50. Type "A" is fitted with gear box giving speeds of 4200—150—25—or 4 R.P.M. Type "B" is fitted with gear box giving speeds of 4200—20—or 5 R.P.M. and is also fitted with blower which has many uses. Both types have extended spindles.

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NEW KINGSLEY SPEAKERS

5 inch per-mag. complete with 10,000 ohm transformer

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EXTENSION-UNIT

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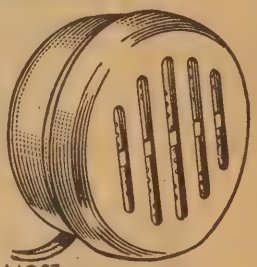

Instal it anywhere, in the sickroom, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker.

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oscillation which does not occur continually but is only shocked into action when the signal reaches a certain level or frequency. When this happens the oscillation usually occupies only a small part of the total cycle and is almost impossible to detect by any other means. The distortion it produces is particularly unpleasant and rather hard to "pick" unless you have experienced it previously.

Hum, particularly in specialised equipment having high gain circuits, can be due to two major causes, the failure of electrolytic condensers in HT circuits or the presence of some form of coupling, often within a valve, between the grid and heater circuits.

A lot of time can often be saved if it is known which is the particular source of trouble and this will be indicated by the frequency of the hum. If it is 50-cycle it is due to leakage or induction from the heater or transformer circuit, while 100-cycle hum is normally the result of poor filtering. With a lot of experience you can sometimes pick the difference by ear, but a CRO will do a positive job.

"HAM" USES

Another use for the CRO, outside the realms of servicing, but which may help to justify its existence, is in the "ham" shack. Apart from its more obvious uses, such as checking modulators for rated power output or tracking down hum in a new preamplifier, it is really most valuable for checking modulation percentage.

From my own observation of the amateur bands, this appears to cause most operators more bother than any other single factor, practically every contact carrying a request to "check my modulation, old man; I think it's about right."

Of course, telling "hams" how to run their stations may be a bit out of my province; but I do know that those fellows, mainly among my own friends, who have proper checking facilities, are able to put out a very much healthier signal on the same carrier strength than those who have not.

For work of this kind, deflection amplifiers are seldom needed, since there is normally plenty of RF voltage available to operate the plates directly. In these circumstances, much higher frequencies can be handled, and my amateur friend advises that he is able to make modulation checks, using the popular trapazoid pattern, at all frequencies up to 144 Mc. I gather that he can't comment on higher frequencies because he has not tried them.

In its most popular form, the CRO consists of the cathode-ray tube proper, a power supply for both it and the auxiliary equipment, amplifiers for the horizontal and vertical deflection plates, and a time base generator.

SIZE OF TUBES

The size of the tubes ranges from 1in. diameter to 5in. diameter, and the final selection will depend on a number of factors. The 1in. types are really intended for specialised use when built into individual instruments, but for general work, the small screen is a serious limitation. On the other hand, it has the advantage of modest power supply requirements, which limits cost by using standard receiver components.

The 2in. screen is a better proposition, though still on the small side. It retains the advantage of requiring only a moderate HT voltage and, once again, standard components can usually be pressed into service.

The 3in. type appears to be a very satisfactory compromise as it provides a good screen area and still does not call for particularly expensive associated gear. Admittedly, the HT voltage is starting to rise and is normally outside the scope of standard transformers, at least if optimum performance is to be expected, but it can usually be accommodated by a small extra winding on the transformer and can still use standard rectifiers and filter condensers. Single-sided amplifiers are still adequate, while the size of the complete instrument is not excessive.

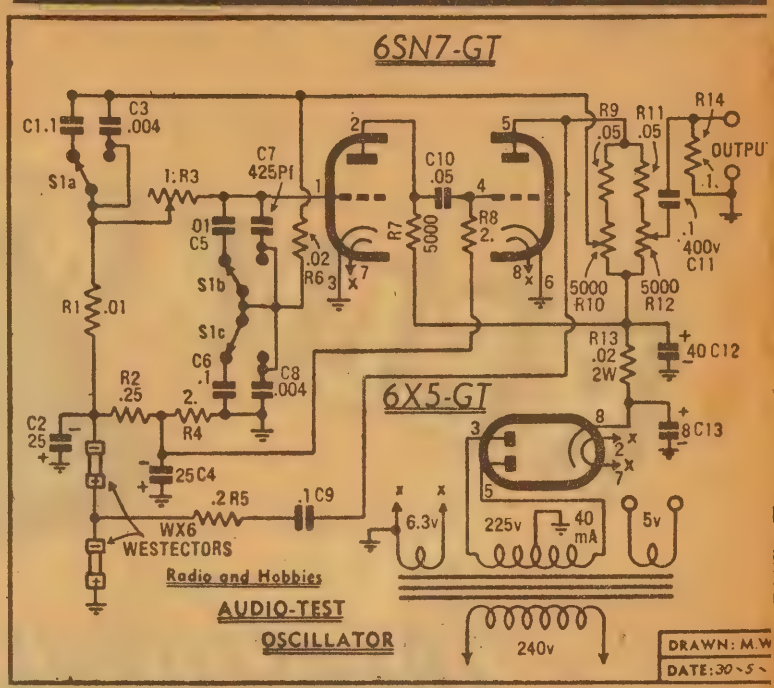
LOW COST TYPES

The next size is the 5in., and the only reason that these have become popular on the service bench is because they were readily available from wartime stocks at only a fraction of their original cost. However, attractive though this may have been, there was a nigger in the woodpile. This was mainly in the form of operating conditions, which differ markedly from the smaller types, both in the HT requirements and the type of deflection amplifiers needed for best results.

As well as the higher cost which this creates, there is the problem of where to house the thing when it is finished, for the case will need to be a very deep one to suit these tubes and it generally happens that the normal shelf above the service bench is far too narrow.

However, regardless of what size you choose, such things as deflection amplifiers and time base circuits will be common to all and a brief resume of these may be helpful.

CIRCUIT OF AUDIO OSCILLATOR



This is just about the simplest audio generator possible but, although it uses only t valves, it is capable of excellent results. An improved version featured an auc amplifier and cathode follower stage, again using the 6SN7.

The sensitivity of the horizo and vertical plates is not very h normally running about 70 or volts per inch of deflection (more less depending on the operating c ditions and type of tube), so that plifiers are necessary to lower to a figure suitable for normal nal levels. The type of amplifier depend on requirements, but it clear that they must be above picion over the range to be cover

TIME BASE

For most purposes this need extend beyond about 50 or 100 although it is possible to push it to the 2 or 3 Mc mark by spe design. Quite naturally an ampli to cover this range of frequen without serious discrimination c for rather careful design and is ha ly justified except in the case special laboratory types. Where higher frequencies have to be hand it is usual to provide amplifiers signed to operate over a narrow b only, and generally tuned to the quired frequency.

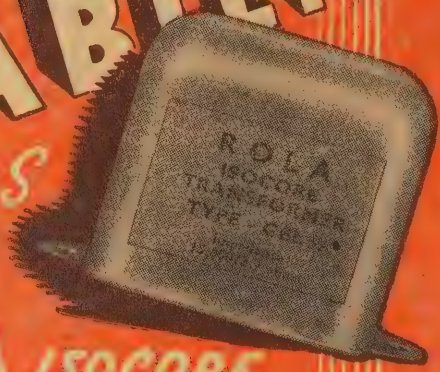
With larger tubes, such as the variety, push-pull amplifiers generally necessary to prevent focusing of the beam when it deflected over the full width of tube. This means at least two ex valves, with associated bits pieces, and is one reason why th sizes entail more expense.

The purpose of the time b is to provide a linear horizontal flection at any frequency over range for which the instrument is signed. There are many ways which this can be achieved, vary from the simple gas triode circuit the compliated hard valve time ba using up to three standard valves

The gas triode system has the vantage of simplicity and low c

RELIABILITY

PLUS



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CHARACTERISTICS

but is not always perfectly linear. Much can be done to improve this by careful design and a lot depends on the voltage which the device is required to deliver, low voltages making linear performance easier. The addition of a linearising valve to the gas triode circuit can eliminate most of these defects and many consider the extra valve is justified.

Hard valve time bases are normally more complicated, and, while many of them are capable of excellent linearity, others are inclined to be cranky and seem dependent on valve characteristics which are inclined to vary from valve to valve. Others again are excellent over a narrow band of frequencies, but call for unduly complex circuits to extend this to a wide range.

SUMMING UP

All the foregoing seems to establish fairly definitely the requirements of a CRO for either the serviceman, fidelity hound or amateur, and these may perhaps be summed up as follows: A two or three inch screen, with a preference for the latter; single-sided amplifiers for both vertical and horizontal deflection, and, ideally, having a response to about 100 Kc; a gas triode time base with, perhaps, a linearising valve, and having a frequency of about 20 cps to 25 Kc; facilities to bypass the amplifiers and make connection directly to one or both sets of deflection plates and, also, provision to connect an external time base to the horizontal amplifier if required.

There appears to be no real reason why you should not build your own, no particular skill is required, and, particularly in the case of the smaller types, only a minimum of special parts which can usually be obtained to order. The saving is generally considerable, assuming, as always, that you have the time available to do the job.

As I inferred earlier, the CRO and the variable audio oscillator are companion instruments and there is not much point in considering one without the other. Of the two, the audio oscillator is probably of more value alone than is the CRO, for it can be used to check the frequency response of amplifiers, speakers, transformers, &c., search for rattles in speakers and cabinet, as well as a host of other jobs, while the CRO is virtually useless unless it has a source of signal.

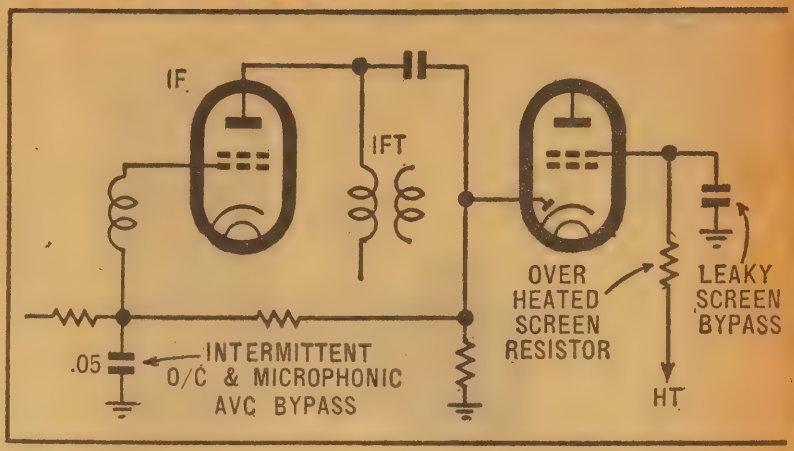
AUDIO GENERATORS

There are two general types of audio oscillator. One is the beat frequency oscillator (BFO) and the other is the Wein bridge or selective feedback arrangement.

The theory behind the BFO is comparatively simple, merely requiring that two RF oscillators, one fixed and one variable, be fed into a detector circuit, so that the difference between them (the beat frequency) appears in the output from the detector. Thus the required audio frequency may be selected by adjusting the variable oscillator to have the required difference from the fixed oscillator.

Which is all so delightfully simple that it is obvious that there must be a catch somewhere—and there is! In practice it calls for extremely careful design to keep the two oscillators completely isolated from each other and, if this is not done, there will be a tendency for the two to lock together when the difference frequency is low, i.e., as would be required to produce a 50 to 100 cycle note.

TROUBLE DUE TO A.V.C. BYPASS



Showing how the intermittent AVC by-pass condenser upset the performance o the set. Even when it was "good" microphonic effects upset the performance at loud volume. The screen by-pass and resistor were replaced before they caused a set failure

Further, it is essential that at least one of the RF oscillators produce a pure wave form, otherwise harmonics of the radio frequencies will beat to produce harmonics of the audio frequencies. Since an RF oscillator usually produces harmonics it is necessary to filter them before the signals are fed to the detector. Even then our troubles are not over, for the detector itself must be distortion-free if it is not to undo all the good work already done.

All this is not to say that the BFO is an impossible instrument, for there are several commercial units capable of excellent results both in the matter of wave form and low frequency response, but the point is that they are not the type of instrument recommended for home construction.

AN EASIER WAY

On the other hand the Wein bridge is free from most of these objections. The basic principle is that of a simple amplifier in which positive feedback can be made to occur at one particular frequency. When this happens the system will oscillate at that freqeuncy but, because the feedback is negative at all other frequencies, the resulting wave form is particularly free from harmonics.

Selecting the frequency at which the system will oscillate is usually quite simple, normally only requiring a variable resistor in the feedback system. This may be calibrated directly in audio frequencies and two or three ranges will generally cover all the frequencies required, although many designs extend well into the supersonic regions.

With the addition of a few refinements, such as some form of AVC system to keep the output substantially constant and perhaps a low impedance output circuit, such a simple oscillator can be made into a really high quality audio generator. Although the circuit lends itself so admirably to home construction there are also some commercial versions available and this system seems to be becoming increasingly popular.

Much the same remarks apply to the oscillator as were made about the CRO—you can buy one ready made if you have the money or build one if you have the time, b you should be able to get a go instrument either way. The edit will probably publish a typical ci cuit of both instruments to give y some idea of what makes them tick

For this month's case I have an ther intermittent fault though, fo tunately, this was of a type that could get my teeth into. My fi introduction to the set was when t owner asked if I would examine in his own home, adding a bri explanation that it went sometim and not at others.

I am never particularly keen working in a customer's home if can avoid it and an intermittent, it obviously was, was about the la kind of fault I wanted to tackle these circumstances. However, t owner was not keen to lose the u of the set, arguing that it went mo of the time, that he had a seri to follow, &c., and couldn't I t and fix it on the spot.

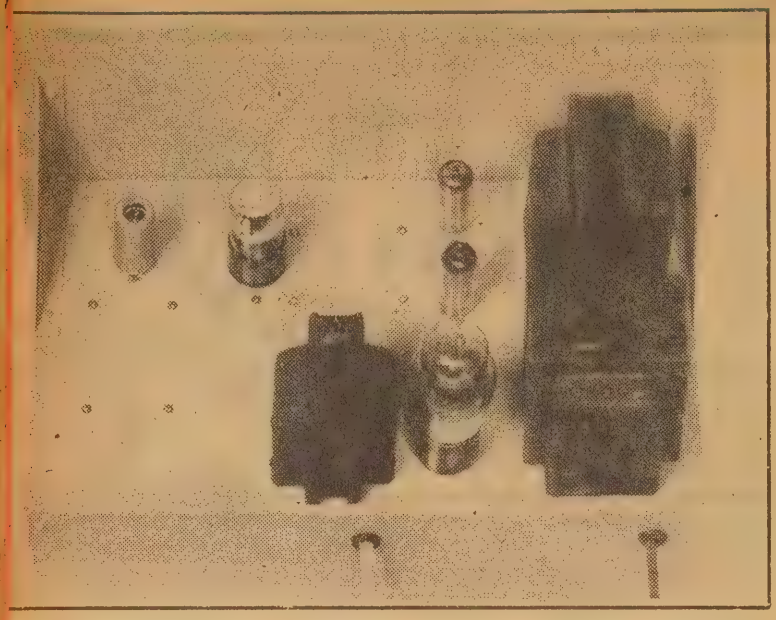
He was right about it working mo of the time, for nothing I could would induce any kind of misb havior and I eventually persuad him to let me take it back to t shop. To avoid interruption of h favorite who-dun-it I offered to le him a spare set and while this pac fied him to some extent, I had t impression that he did not altogeth trust servicemen and that I was exception.

MICROPHONY

Anyway, to get back to the set a its defects. It was a five-valve ma tel set, some four or five years ol and a preliminary check showed more or less normal performanc I set it running on the bench wi the AVC and HT under observatio and waited for things to happe Nothing much did until I decid that I really wanted to hear one the programs it was playing a turned the gain up, perhaps a litt higher than normal listening lev

The result was exactly as if the s had a badly microphonic valve, lou passages setting up the well-know acoustic howl like a PA system o of control. I went over each of t valves, tapping them gently, b none seemed unduly sensitive and

(Continued on Page 109)



All components above the chassis are visible in this rear photograph. Along the front from left to right are: 6AU6, 6SN7-GT, 6BW6'S and modulation transformer. At the rear of the chassis are the choke, 5V4-G and power transformer.

SIMPLE 10-WATT MODULATOR

The companion modulator for the simple 4-band transmitter, described last month, delivers 10 watts of clean audio power at the secondary of the modulation transformer. Expensive components have been avoided where possible without prejudicing performance.

by Maurice Findlay

F the several methods of amplitude modulating a carrier wave, by the most popular is plate modulan. Other methods, such as cathode dulation and grid bias modulation, ile achieving the desired result, so at the cost of lower overall iciency and the need for critical justments and, for these reasons, not often used by amateurs.

n the case of plate modulation, modulating voltage is applied series with the plate (or plate and een in the case of a tetrode) pply of the class C amplifier feed- the aerial, so that, in effect, the dulator varies the high tension ltage applied to it in sympathy th audio voltages fed through the crophone.

OLTAGE REQUIRED

In order to modulate the carrier ve 100 pc, the modulator must be pable of cutting the high tension pply voltage completely on the gative voice peaks and doubling e supply voltage on positive peaks. the final amplifier is properly utralised and adjusted for class C nditions the RF power delivered to the aerial will vary in proporn with the high tension voltage.

For 100 pc modulation, the modulor must deliver audio power equal half the DC power input to the class C amplifier. In our case the DC input to the final 6BW6 is 350 volts at 50 mA, which works out to 17½ watts, so that the modulator must be capable of delivering about 9 watts of audio power.

The requirements for a modulator are somewhat different to those of an audio amplifier feeding into a loudspeaker. While a loudspeaker has an impedance characteristic which varies over a wide range, according to the frequency, a modulator delivers its power into a load which behaves exactly like a resistor. Furthermore, while good quality is desirable, a high fidelity system is of no special advantage for communication purposes.

In order to convey a clearly intelligible message, audio frequencies between about 200 and 3500 cycles are required. If you extend the range beyond these limits the result will certainly be a more faithful reproduction of the original speech, but power which does not contribute to intelligibility will be more or less wasted.

This is particularly true of the lower frequencies. If speech is faithfully reproduced, it is found that a lot of power goes into voice notes around about the 200 cycle mark. But it is the notes from 1000 to 2000 cycles which contribute most to intelligibility. It is obvious, therefore, that with a given power better intelligibility can be obtained if the modulator is adjusted so that the lower frequencies are attenuated somewhat.

INTELLIGIBILITY

At the low frequency end of the voice spectrum are the notes which add lifelike qualities to the voice. However, they can be attenuated to a considerable degree without impairing the intelligibility of the signal.

In amateur transmitters it is also considered desirable to limit the extreme high frequency response in order to limit the bandwidth of the transmission. Furthermore, communication receivers usually have a high degree of selectivity which severely limits anyway the reproduction of the higher frequencies. Thus, while reasonably good high frequency response is desirable, there is no point in striving for an extended range.

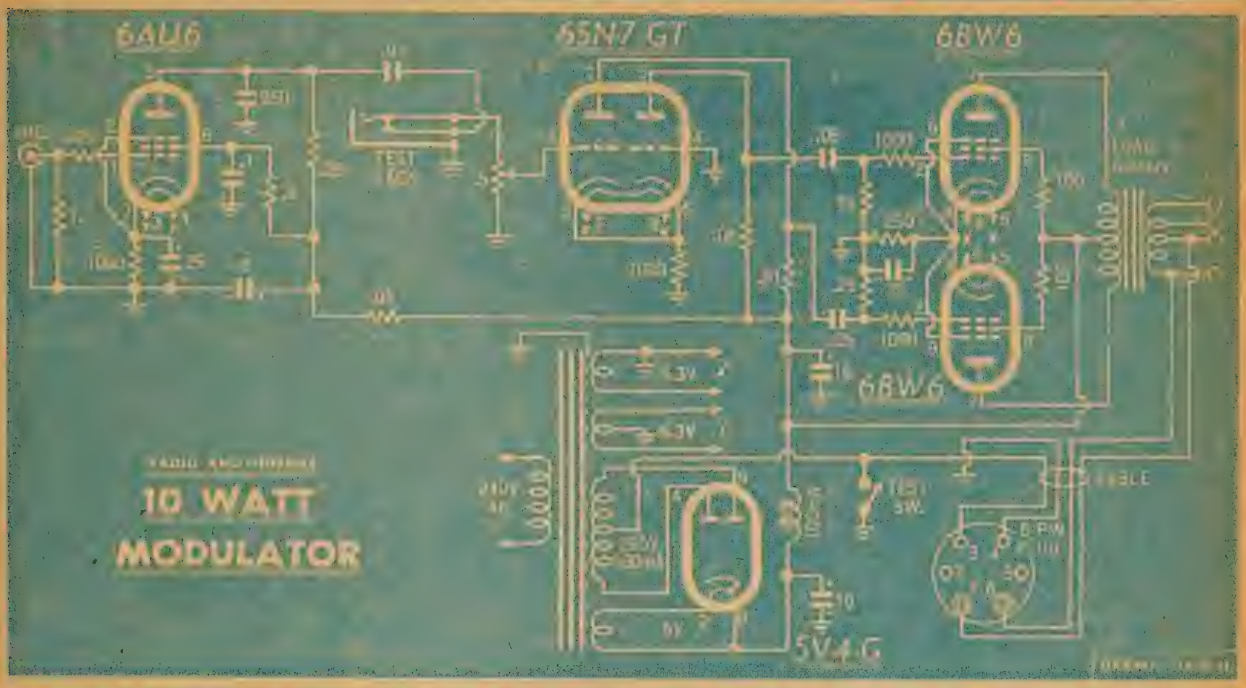
Having considered the broad requirements for a modulator for an amateur transmitter, we can go on to discuss the particular problems in designing a modulator for last month's transmitter.

OUTPUT STAGE

The audio power requirements for full modulation can be met easily with a pair of 6BW6's in class AB1, and, since 6BW6's are used in the transmitter, it is logical that they be used in the modulator also. Of course, 6V6-GT's may be used if desired, since they have very similar characteristics to the 6BW6's. Actually, the layout allows plenty of room for 6V6-G's should you happen to have a pair of these available.

According to the manufacturer's data, 6BW6's in class AB1 will deliver 12 watts given a plate and screen supply of 285 volts. This particular rating allows a simple system of automatic bias to be used. The bias works out at about 20 volts, so that a total supply of about 300 volts is required.

Using a 285-volt high tension transformer and a 5V4-G rectifier with condenser input to the filter,



The circuit is as simple as possible consistent with good performance. Note the stopper resistor in the preamplifier grid and also the phase changer arrangement. The power output of 10 watts at the secondary of the modulation transformer is more than sufficient to modulate the transmitter described last month.

the high tension voltage works out to the required figure. As the current drain of the output valves is about 70 mA and the remaining valves in the modulator take comparatively little current, a 100 mA transformer is specified.

As the output valves are operated in class AB1 there is no grid current flowing, and a system of resistance coupling from the driver stage is satisfactory.

The conventional phase-changer with equal loads in plate and cathode circuit could be used, but the arrangement finally adopted has a number of advantages. In addition to providing a useful degree of gain it provides a low impedance drive source, which helps to improve the characteristics of the output stage when subject to slight overload. Obviously, however, two triode elements are required.

VALVE SUPPLY

Unfortunately the twin triodes in the miniature series are in poor supply at the moment, so that the 6SN7-GT is the most suitable valve for the position of phase-changer.

The valve line-up is completed by a 6AU6 preamplifier stage which amplifies the output of the microphone to a level suitable for application to the phase-changer.

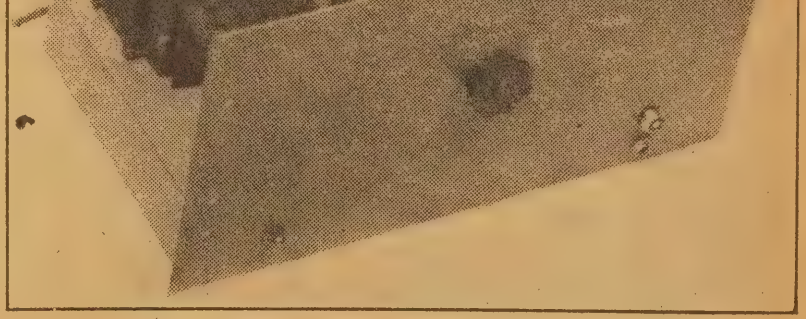
In designing the electrical circuit, we have more or less assumed the use of a diaphragm type crystal microphone, since it has several important advantages over other types for amateur work. Crystal microphones are readily available and, as your purse permits, you can buy anything ranging from a high fidelity job complete with chromium-plated case and desk stand to a replacement insert which you can install in a home-made case.

In our case, a good quality insert was installed in a bakelite case originally intended for a carbon microphone and used in conjunction with a military transmitter. However, if one of these is not available you can use your ingenuity to manufacture one from wood or metal.

Some crystal microphones exhibit noticeable peaks within the voice range, their usual effects being to accentuate the sibilants. We have found that the overall characteristics of the microphone can often be improved by placing one or more layers of cloth over the microphone.

A good idea is to connect the modulator to a loudspeaker and have a technically-minded friend listen while you try speaking through the microphone with varying amounts of acoustic filtering in front of it. If the microphone is installed in its case you will have an opportunity to verify that the latter does not introduce any undesirable resonance effects at the same time.

Crystal microphones have a high



When this picture was taken the gain control was mounted just above the centre of the panel, the idea being to obtain a balanced appearance. If you wish to install a meter, it would be placed in this position while the gain control would be placed below the chassis.

STANDARD OUTPUT TRANSFORMER RANGE BY

Tel.: JA2877
JA2878

-FERGUSON-

FERGUSON LANE,
CHATSWOOD.

P.A. RANGE 50-8000 cps Output to Voice Coil

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
10	5000, 2500 SE	12.5 8, 2.3	83/9		OP-1
10	5000, 2500 SE	5, 2.7	85/2		OP33
10	5500 SE	3.7	88/2		OP-41
10	30,000 20,000, 14,000, 10,000, 7000, 5000, 2500 PP	2.3	79/7	Universal Test Loud Speaker	OP-53
10	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2.	88/2		OP-54
10	5000, 2500 SE	15.	85/2		OP-39
10	10,000 PP	15, 8.4, 2.3	88/2	5W Cath Amplifier	OP-85
10	7000 PP	Any ONE of following impedances — 15, 12.5, 8.4, 2.3, 2.	88/2	9W Cath Amplifier	OP-92
15	5000 PP	12.5, 8, 2.3	129/5		OP-2
15	6600 PP	12.5, 8, 2.3	129/5		OP-3
15	10,000 PP	12.5, 8, 2.3	129/5		OP-4
15	10,000, 6600, 5000 PP	12.5, 8, 2.3	129/5		OP-5
15	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	129/-		OP-55
15	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	129/-		OP-56
15	10,000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	129/-		OP-57
15	10,000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	130/10		OP-58
25	10,000 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	163/9		OP-59
32	10,000 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	208/9		OP-60
60	3800 PP	17.6	203/7		OP-36
60	3800 PP	100, 75, 50, 25, 10, 5, 2	238/9		OP-61

P.A. RANGE 50-8000 cps Output to Line

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
10	5000, 2500 SE	500	83/9		OP-1A
10	5000, 2500 SE	500, 250, 125	90/8		OP-44
15	5000 PP	500, 250, 125	129/5		OP-6
15	6600 PP	500, 250, 125	129/5		OP-7
15	1000 PP	500, 250, 125	129/5		OP-8
15	10,000 PP	500, 250, 160, 125, 100, 83.5, 71.5, 62.5, 55.5, 50	137/6		OP-8M
15	10,000, 6600, 5000 PP	500, 250, 125	129/5		OP-9
15	5000 PP	600, 300, 200, 150, 130, 100, 75, 50	140/3		OP-34
15	8000 PP	600, 300, 120, 60, 30	245/-		OP-50
25	5000 PP	500, 250, 125	156/3		OP-10
25	6600 PP	500, 250, 125	156/3		OP-11
25	10,000 PP	500, 250, 125	156/3		OP-12

P.A. RANGE Cont.

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
25	10,000, 6600, 5000 PP	500, 250, 125	156/3		OP-13
25	10,000, 6600 PP	500, 4000, 8.4, 2.2	200/10	Cutting and Playback Amplifier	OP-35
25	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	245/		OP-38
32	5000 PP	500, 250, 125	189/2		OP-14
32	6600 PP	500, 250, 125	189/2		OP-15
32	6600 PP	500, 250, 166, 125, 100, 83.5, 71.5, 62.5, 55.5, 50	192/3		OP-15M
32	10,000 PP	500, 250, 125	189/2		OP-16
32	10,000, 6600, 5000 PP	500, 250, 125	189/2		OP-17
32	6600 PP	140, 70	209/		OP-48
60	3800 PP	500, 250, 125	206/3		OP-18
60	3800 PP	100, 75, 50, 10, 5, 2	238/9		OP-61
80	6400 PP	500, 250, 125	253/2		OP-37
105	8800, 6000 PP	500	382/6		OP-49
150	11,600, 8400 PP	500, 250, 166, 125	481/8		OP-20

HI-FI RANGE 30—15000cps Output to Voice Coil

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
5	5000 SE	Any ONE of the following impedances 15, 12.5, 8.4, 6.5, 2.1	82/6	4W Baby Playmaster	OP-24
10	3250 SE	12.5, 8.4, 2.3	132/1	R & H Vox Major	OP-23
10	5000 SE	2	112/6	For Rola 120x Speaker	OP-113
10	5000 PP	2	112/6	For Rola 120x Speaker	OP-117
10	6600 PP	2	112/6	For Rola 120x Speaker	OP-119
10	8000 PP	2	112/6	For Rola 120x Speaker	OP-118
10	10,000 PP	2	112/6	For Rola 120x Speaker	OP-112
15	5000 PP	12.5, 8, 2.3	192/3		OP-19A
15	10,000 PP	15, 3.75	186/11	10W Playmaster	OP-63
15	10,000 PP	12.5, 3.125	186/11		OP64
15	10,000 PP	8.4, 2.1	186/11		OP-65
20	4500 PP	15.5, 12.5, 8.6, 2.7, 2	164/2	15 & 32W Cathamplifiers	OP-51

Output to line

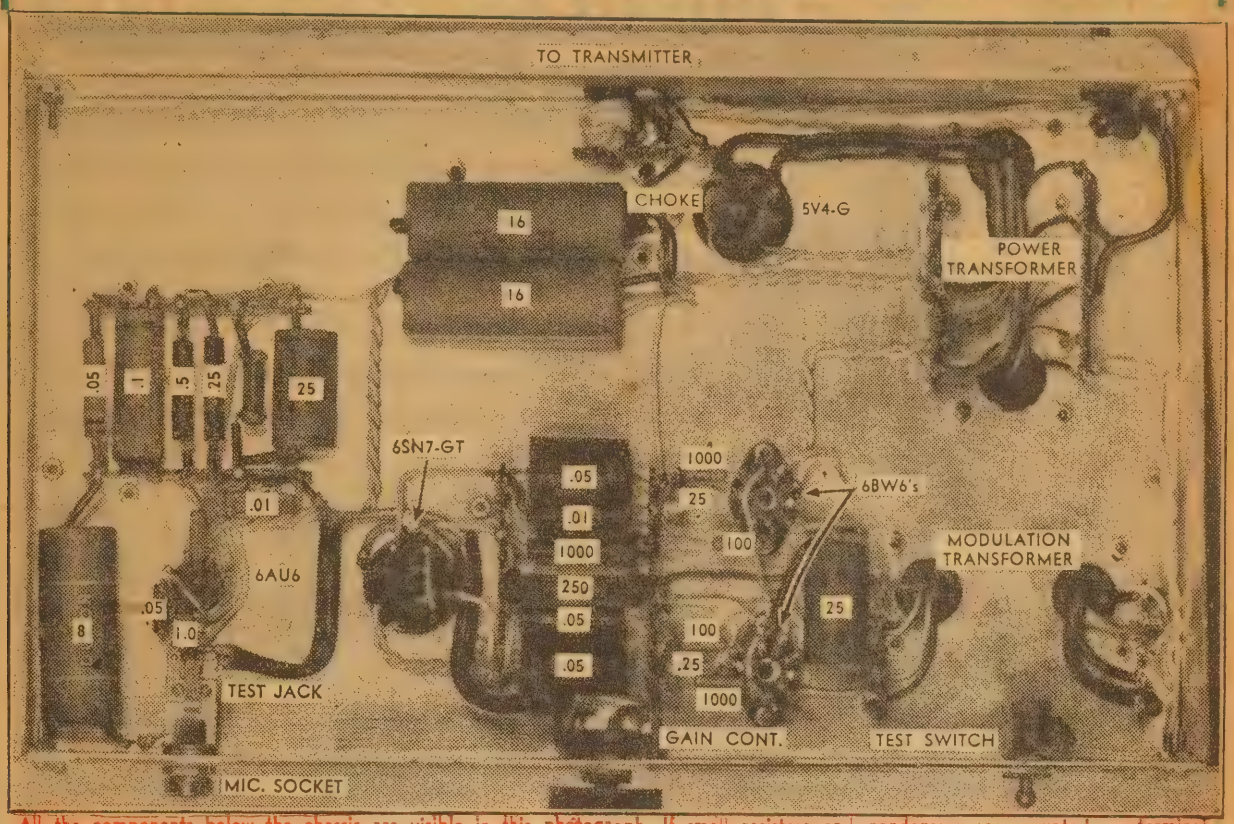
Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
10	3250 SE	500, 250, 125	132/1		OP-22
15	5000 PP	500, 250, 125	192/3		OP-19B
15	10,000 PP	500, 125	186/11		OP-62

SPECIAL HI-FI RANGE 20-30000 cps

Wts	Primary Impedance	Secondary Impedance	Retail Price	Special Application	Code No.
15	10,000 PP	8.4, 2.1	192/9	For Williamson Amp.	OP25/8.4
15	10,000 PP	10, 2.5	192/9	For Williamson Amp.	OP25/10
15	10,000 PP	12, 3	192/9	For Williamson Amp.	OP25/12
15	10,000 PP	15, 3.75	192/9	For Williamson Amp.	OP25/15
15	10,000 PP	16, 4	192/9	For Williamson Amp.	OP25/16
15	10,000 PP	40, 10	192/9	For Williamson Amp.	OP25/40
15	10,000 PP	250, 62.5	192/9	For Williamson Amp.	OP25/250
15	10,000 PP	500, 125	192/9	For Williamson Amp.	OP25/500
15	5000 PP	8.4, 2.1	235/-		OP-66
15	5000 PP	15, 3.75	235/-		OP-67

ENGINEERED **TO-DAY** FOR **TO-MORROW'S** REQUIREMENTS

LABELLED PHOTOGRAPH IDENTIFIES COMPONENTS



All the components below the chassis are visible in this photograph. If small resistors and condensers are mounted on terminal strips as shown, you should have no difficulty in making a neat wiring job. The microphone socket and test jack are mounted one above the other on the left. Note the front photograph on page 57.

impedance output, and therefore may be fed into the grid of the preamplifier valve without the need for a matching transformer. A further advantage is that the shielded cable may be extended without affecting the frequency response. If an excessive length of high capacity cable is used there will be a drop in output.

On the other hand, microphones of the moving coil and ribbon types are generally more expensive than crystal types of equivalent quality, and they require a transformer to step-up the output before it can be fed into the grid of a valve. A transformer handling low-level signals introduces special problems of shielding if hum is to be avoided.

MICROPHONES

Carbon microphones not only require a step-up transformer but it is necessary to provide an excitation voltage. The level is fairly high so that hum is not usually a problem, but the poor frequency response, combined with a high degree of harmonic distortion, make the quality of most carbon microphones very poor. Nowadays they are generally reserved for equipment where cheapness and compactness are the most important considerations.

With a crystal microphone the bass response can be varied by varying the load resistance. For full bass response the recommended load resistance is in the vicinity of 5 megohms, but for communication work a load resistance in the vicinity of 1 meg will give a desirable characteristic. This is another point which you can subject to experiment. In one case we found that best results were achieved with a load of .5 meg.

For 10 watts output with the gain control turned full on, an input signal of about .01 volts is required. Therefore there is a reserve of gain for the average crystal microphone which has an output of about .02 volts.

From the "full off" to the "full on" position the usual tapered potentiometer usually rotates through 270 degrees. Under average speaking conditions we found that the modulation was approaching 100 pc on peaks with the gain control turned three-quarters full on. This is a matter

MODULATOR PARTS LIST

- 1 chassis 14in x 8½in x 2¼in
- 1 panel 15½in x 8in
- 2 brackets 4in x 4in
- 1 power transformer, 285V 100mA, 6.3V 2A, 6.3V 2A CT and 5V 2A.
- 1 power choke, 10H 100mA.
- 1 modulation transformer, 25W, 8000 CT ohms to 7000 ohms (other tappings desirable)

VALVES

- 1 6AU6
- 1 6SN7-GT
- 2 6BW6
- 1 5V4-G

CONDENSERS

- 2 25 mfd 40PV
- 2 16 mfd 525PV
- 1 8 mfd 525PV
- 1 .1 mfd 400V
- 2 .05 mfd 400V
- 1 .01 mfd mica
- 1 250 pf mica

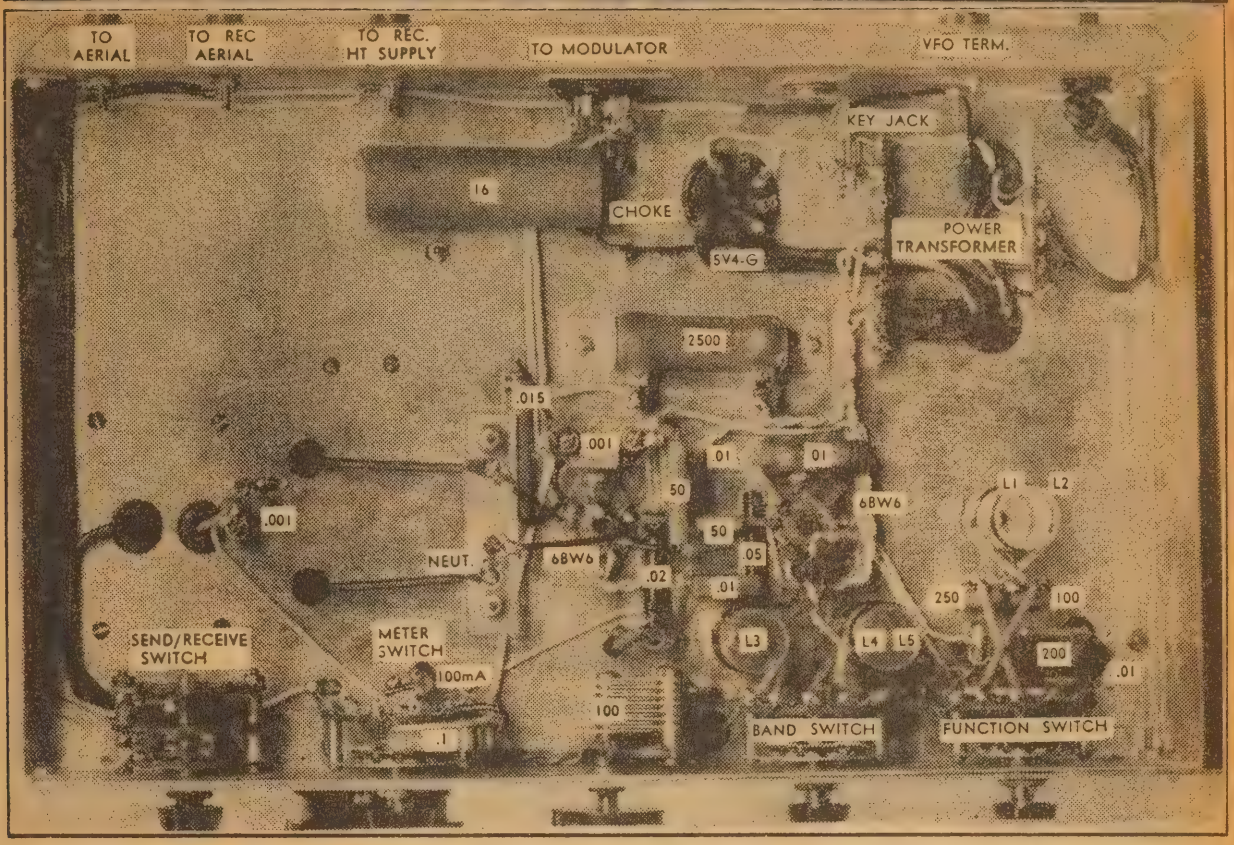
RESISTORS

- 1 1.0 meg ½ watt
- 1 .5 meg 1 watt
- 1 .5 meg potentiometer
- 1 .25 meg 1 watt
- 2 .25 meg ½ watt
- 2 .05 meg 1 watt
- 1 .05 meg ½ watt
- 1 .01 meg 1 watt
- 2 2000 ohm 1 watt
- 1 1000 ohm 1 watt
- 2 1000 ohm ½ watt
- 2 100 ohm ½ watt
- 1 250 ohm 5 watt

SUNDRIES:

2 octal sockets, 2 9-pin miniature sockets, 1 7-pin miniature socket with shield, 1 6-pin plug, 1 toggle switch, 1 microphone socket, 1 closed circuit jack, 1 pointer knob, shielded wire, hook-up wire, spaghetti, terminal strips, power flex, nuts and bolts, etc.

UNDERCHASSIS DETAILS OF SIMPLE TRANSMITTER



This labelled photograph will help you to place the components underneath the transmitter chassis. Since last month's issue was published, the transmitter has been used on the air with consistently good results.

which, of course, will vary widely and for which individual adjustments will have to be made. Modulation is best adjusted with the aid of a cathode ray oscilloscope, but we will have more to say about this later.

The circuit of the modulator is fairly straightforward, apart from the special features already mentioned. You will note that we have included a .05 meg stopping resistor in the grid circuit of the preamplifier. On the higher frequency bands it was originally found possible to induce RF feedback with the gain control turned fully on. However, with the stopper resistor in place no sign of feedback was observed, even on 28 Mc with the gain control turned full on and the microphone cable held near the final tank coil.

COMMON EARTH POINT

Use a single earth point for all the returns associated with the preamplifier stage, as indicated by the schematic diagram, in order to avoid hum from currents induced in the chassis by the power transformer field.

A small condenser is wired from the plate of the 6AU6 to earth in order to limit the extreme high frequency response. With the 250 pf shown on the circuit diagram the curve is down 3 db at 3 Kc and 6 db down at 5 Kc.

If the value of the condenser is increased to 500 pf the overall response of the modulator is down 6 db at 3 Kc and 10 db at 5 Kc. This is a greater attenuation than most amateurs will require, but is suggested as a possible cure for, say, microphones with a peak at the high frequency end of the range.

Plate, screen and cathode resistors of the microphone preamplifier stage are the manufacturers' recommendations for the 6AU6 and require no special comment. A conventional decoupling network, consisting of a .05 mfd resistor and an 8 mfd condenser, is included to prevent coupling through the power supply and possible low frequency oscillation.

Coupling from the plate of the 6AU6 to the grid of the 6SN7-GT is made via a closed circuit jack, so that high level signals for testing purposes can be fed into the modulator without overloading the microphone pre-

TRANSMITTER PARTS LIST

1 Panel 15½in x 8in
1 chassis 14in x 8½in x 2½in
1 power transformer, 385V 100mA, 6.3V 2A, 6.3V CT. 2A, 5V 2A
1 power choke, 10H 100mA
1 2 gang condenser, 400 pf per section
1 meter, 0-5mA
1 midget variable condenser, 100 pf

VALVES
2 6BW6's
1 5V4-G

SWITCHES
1 2 bank, 3 pole, 3 position
3 single bank, 2 pole, 5 position

CONDENSERS
1 16 mfd, 600PV
4 .01 mfd, mica
2 .001 mfd, mica
1 250 pf, mica
1 100 pf, mica
1 50 pf, mica
Neut. condenser (see text)

RESISTORS
1 .1 meg 2 watt
2 .05 meg 1 watt
1 .02 meg 1 watt
1 .015 meg 2 watt
1 2500 ohm 20 watt
1 1000 ohm 1 watt
1 200 ohm 1 watt
1 50 ohm 3 watt
1 100mA shunt (to suit meter)

SUNDRIES
Lengths of 9, 14, 20, 25 & 28 B&S enam. wire, 3 2in coil formers, 3 ¾in coil formers, 3/16in thick polystyrene, scrap brass, 5 5/32in sockets, 25 banana plugs, 1 octal socket, 1 6-pin socket, 2 9-pin sockets, crystal sockets (to suit crystals), closed circuit jack, 8 terminals, 4 pointer knobs, 1 small round knob, 1 large knob with scale, insulating coupler, rubber grommets, tag strips, ebonite pillars, hook-up wire, spaghetti, 70 ohm twin-lead, power flex, nuts and bolts, solder lugs, &c.

3 NEW MEMBERS join the ZEPHYR team!

There is now a Zephyr mike for every need. We proudly announce three of our latest productions: the Zephyr "40" series — a medium-priced, high-grade velocity microphone; the Zephyr "80" series — an exceptionally fine dynamic mike; and another member of the XA series, Zephyr 5XA — a brilliant omni-directional crystal microphone. See the full Zephyr range at any Radio Supply House or Pyrox Distributor, or write for full technical details and prices.

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ZEPHYR

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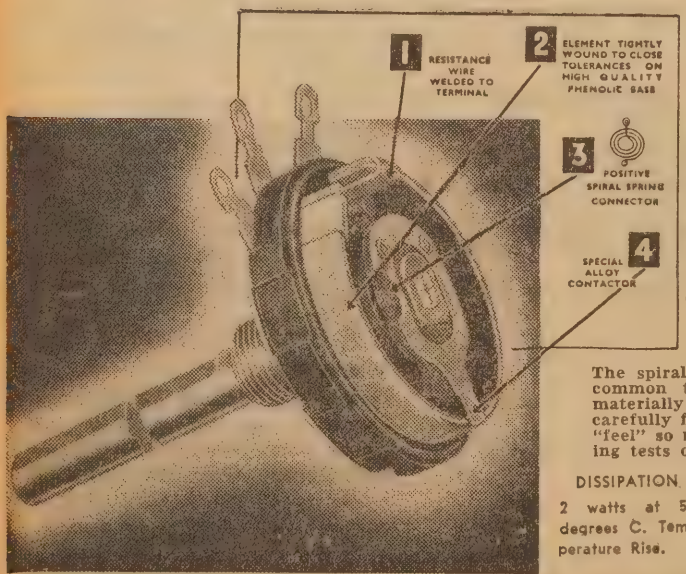
118 WATTLETREE ROAD, ARMADALE, S.E.3. CABLE "CUNNIG" MELBOURNE TELEPHONE UY6174

Announcing... NEW ADVANCED DESIGN



IRC

TYPE W *Wire Wound* CONTROLS

By combining the well-known spiral spring connector and a simple time-tested contactor assembly with an accurate, tightly wound element. IRC engineers have provided a potentiometer having excellent mechanical and electrical characteristics.

The spiral spring connector not only eliminates a cause of noise common to ordinary collector ring type units, but contributes materially to smoothness of operation. Highest quality materials carefully fabricated and assembled ensure long life plus the smooth "feel" so much desired in this type of control. Your own engineering tests on this newest IRC product will prove convincing.

DISSIPATION	SHAFTS	RESISTANCE VALUES	DIMENSIONS
2 watts at 50 degrees C. Temperature Rise.	1/4" diameter. 3/8" bushing. Standard shaft length 2 1/4" from front plate to end of spindle.	All ranges from 5 ohms to 10,000 ohms. Standard tolerance plus-minus 10 pc.	1 1/4" diameter. Depth from mounting face, 9/16."

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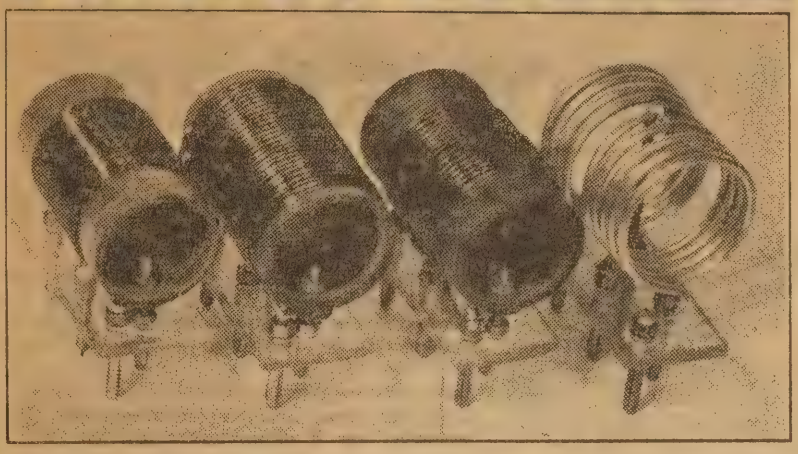
COILS FOR NEW TRANSMITTER



Four plug-in coils are required to cover the four amateur bands between 3.5 and 28 Mc. The bases are pieces of polystyrene 2¾in by 1¾in by 3/16in. Banana plugs are used to make the connections.

amplifier. The gain control is also included at this point.

A signal fed into the grid of the first section of the 6SN7-GT is amplified and appears across both the .01 meg plate load resistor and the 1000 cathode resistor. As the grid of the second section of the 6SN7-GT is earthed and the two cathodes connected together, a signal appears between grid and cathode of the second section of the 6SN7-GT, which is amplified in turn and appears across the .05 meg plate load resistors.

BALANCING THE DRIVE

The .01 and .05 meg plate load resistors of the respective stages are proportioned so that approximately equal (out of phase) voltages are developed across them. Provided the resistors are within the usual 10 pc tolerance, the drive applied to both 6BW6's will be so nearly equal that the difference will not be important.

The grid return resistors for the 6BW6's are .25 meg rather than the usual .5 meg, the object being to improve the overload characteristic of the output stage. The low plate resistance and the low values of load in the plate circuit of the 6SN7-GT are also of assistance in giving the amplifier a smooth overload characteristic.

Finally, stopping resistors are included in the grid and screen circuits of the 6BW6's to counteract the tendency that high gain valves of this nature have to oscillate parasitically at very high frequencies. As the modulator is intended to feed into a load of constant impedance rather than a loudspeaker, no provision for negative feedback is made.

SIMILAR CHASSIS

The modulator is constructed on a chassis of the same size as the transmitter namely 14in by 8¼in by 2¼in. There is plenty of room to mount all components in a logical fashion and also possible additions at a later stage should these be required.

The panels for the transmitter and the modulator are both 15½in by 8in so that the two units will assume a neat appearance, either mounted side by side on the operating table or one above the other, in the conventional rack arrangement.

With the latter in mind, the microphone preamplifier stage is mounted in the front right hand corner of the chassis (looking from the front). In this position it is as far as possible from the transmitter power transformer and the risk of hum due to magnetic coupling. The modulator power transformer is mounted in the opposite corner of the chassis to the microphone preamplifier for the same reason.

The phase changer, output valves and modulation transformer are mounted across the front of the chassis in logical order, space being left for a transformer to couple the driver valve to the push-pull output valves should you wish to follow this arrangement at a later date.

The space along the back of the chassis is occupied by the power supply components arranged in order. Should you wish later to include a tone generator, speech clipper or other auxiliary, space is available at the rear of the chassis behind the microphone preamplifier.

CONSTRUCTION

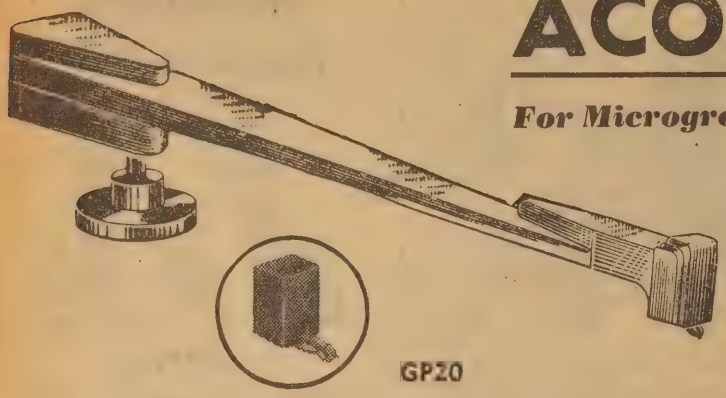
With the aid of the labelled photographs and lists of parts, the job of constructing either the transmitter or the modulator should be very little more difficult than the job of constructing an ordinary 5 valve broadcast receiver. We have managed to squeeze in a coded underneath photo of the transmitter which may be of value to some. Of the two units, possibly the transmitter is the more difficult. Care should be taken to wind the coils exactly as specified. Other parts, such as the coil bases have to be constructed by hand, the shunt resistor requires individual adjustment and as with any transmitter final operating adjustments are required before it can be considered complete.

Do not be tempted to hurry the job. Even if you do decide at a later date to build a high-powered transmitter, the small job will still find a special place in your amateur activities. Its small size and light weight immediately suggest its operation under emergency or portable conditions, possibly adapted to operate from an accumulator supply.

The Finest Pick-up Available

ACOS G.P. 20

For Microgroove and Standard Recordings



GP20

Inset: The long-playing head. (GP-19LP) interchangeable with Standard Head (GP-19).

GP9 Cartridge to fit GP10 Pickup .. Price **36/9**

GP20

The GP20 pick-up is designed for use with the standard 78 rpm records or the 33 1-3 or 45 rpm long-playing microgroove records. To meet these differing requirements, two interchangeable slide-on heads are available.

GP19 head supplied as standard.

GP19 L.P. head available for microgroove. It is something new in pick-up design and has 20 times greater output than comparable magnetic types, while needle talk and motor rumble are practically non-existent — permanent sapphire stylus — wide frequency response.

PRICE .. GP20, complete with standard head £6/3/6
PRICE .. GP19 LP head £3/11/-
PRICE .. GP19 standard head £3/11/-

ACOS MICROPHONES and MIKE INSERTS

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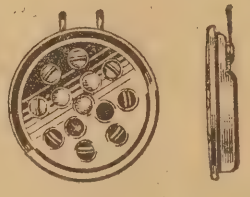
MIC3 Diaphragm-actuated Crystal microphone specially designed for the reproduction of speech frequencies. With rising response from 1000 c/s, this microphone has exceptional sensitivity.
PRICE, 35/3.



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MIC14 Standard Speech Microphone itself with nickel-plate brass case which gives high corosion resistance, mechanical strength and rigidity.
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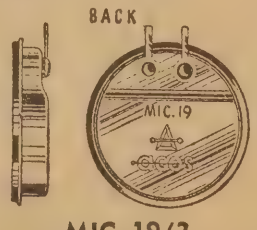

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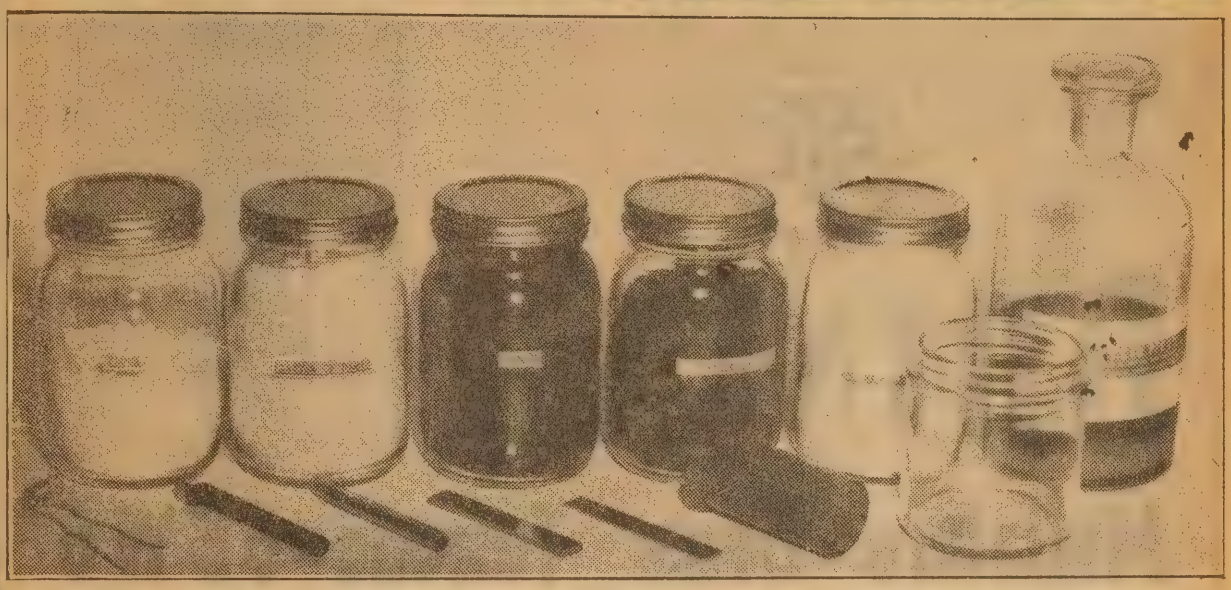
ELECTRIC POWER FROM CHEMICALS



Here are some of the chemicals we used in the experiments. You can buy them from chemists or scientific supply stores but your science teacher may be willing to give you the small quantities you will need. Details are given in the article.

In our "Junior Experimenter" series this month we discuss quite a new phase of electrical phenomena. By a series of experiments which you can carry out for yourself, we show how electricity can be obtained from chemicals.

YOU will remember that we have already experimented with two ways of generating electricity from mechanical energy. First, there was the method which involved rubbing pieces of insulating material. You will remember that, while some very intriguing experiments could be performed to demonstrate its presence, the electricity so generated was of very little practical use.

Another series of experiments showed the connection between magnetic fields and electric currents. By moving a conducting wire in a magnetic field it was found possible to generate a very useful amount of current. In fact, it is this method that is used in the great power stations which supply electricity for city and towns.

However there is a third, and in its own way, equally important means by which electric currents may be obtained.

ENERGY FROM WOOD

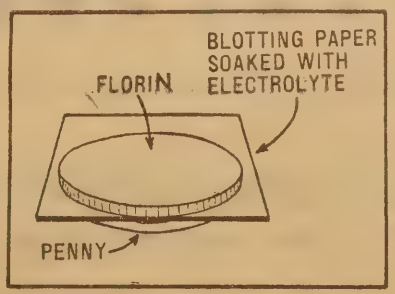
Many substances with which you are familiar are capable of supplying energy in useful forms. Take a piece of wood for instance.

If you burn a piece of wood under a boiler, the heat given out by the wood is transferred to the water which turns to steam. The steam exerts a high pressure which, in turn, can be used to drive the blades of a turbine. In other words, the chemical energy of the wood can be converted to mechanical energy by means of the steam turbine. You will be able to think of dozens of other examples.

Remembering the above illustration with which you are very familiar, you will not consider it strange that electrical energy can also be obtained from a chemical change of various substances. There are many ways in which this can be done and some of them we will talk about in this article.

The first man to generate electric currents chemically was an Italian physicist named Alessandro Volta who carried out his famous experiment in 1799. The exact details of Volta's experiment do not matter, but you can easily perform a similar experiment at home to illustrate how a simple battery operates.

Take an ordinary 1d piece and a 2/- piece. Moisten a piece of blotting paper with lemon juice and place it between the coins pressing them together firmly. If you have a pair of sensitive headphones touch one wire from the phones to one of the coins and the other to the remaining coin.



A simple electric cell can be made from a copper and a silver coin and a piece of blotting paper dampened with lemon juice. It delivers sufficient current to make a sound in a pair of headphones.

As the circuit is completed you will hear a faint but distinct "click" in the phones indicating that a current is flowing "through" them. A very sensitive meter will read the current delivered by the simple cell.

TRY THIS ONE

We tried the experiment using a solution of a chemical called ammonium chloride and found that a battery of 5 cells developed 0.3 volts and was capable of delivering a current of 5 milliamperes. We even tried moistening the blotting paper with saliva. The cell delivered the same 0.3 volts but the maximum current was only 1 milliampere—still enough to be heard in the headphones!

Try the same experiment, but this time with two copper coins or two silver coins. Again, try with the copper and silver but moisten the blotting paper with water. In neither case will there be any detectable results.

Thus you can demonstrate that the action of the electric cell depends on there being two different metals and also on the moist material between them having special properties. If you wish you can try all sorts of substances for the plates of the cell and different liquids for the electrolyte, as the moist material is called when used in connection with batteries.

A novel electric cell can be made with an ordinary lemon. We found

THE NEW

BRIMAR

Miniature Beam Tetrode - 6BW6

The 6BW6 is a miniature Beam Tetrode employing the Noval type of base and envelope. In its characteristics it resembles the 6V6G but has greater output. It may be used with plate potentials up to 315 Volts and with a screen voltage of 225, an output of five and a half watts can be obtained with 12% distortion.

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See the Editorial article on Page 56 of this issue of Radio & Hobbies, "A Simple 10-watt Modulator."

that if a piece of copper wire and an iron nail were stuck into the lemon (they shouldn't touch each other) the electricity generated could be detected with a pair of phones. The two pieces of metal act as the plates of the cell and the lemon juice as the electrolyte. The lemon juice is acid and, in general, acids work very well as electrolytes.

The next logical step is to try different substances for the poles of the battery and different electrolytes on a larger scale and observe the results.

Tables showing what you can expect can be found in text books on chemistry but we found it interesting to try some experimenting for ourselves.

PRACTICAL RESULTS

We half filled a glass jar with ammonium chloride, or sal-ammoniac as it is sometimes called. (Ammonium chloride is a white powder.) You can dissolve several tablespoons full in a cup of water.

We obtained a rod of carbon from an old dry battery and the copper zinc and aluminium from a scrap box. These substances were dipped in the solution in all possible combinations and the electrical pressure they generated measured with a meter. Note the results shown in the table. They differ slightly from those shown in the textbooks but there are special reasons why this is so.

Another electrolyte consisting of 9 parts water and 1 part sulphuric acid was tried with the results shown.

By the way, sulphuric acid is very dangerous. It will damage wookwork, clothing and other materials not to mention your skin. If you decide to try the experiment, be particularly careful not to spill any. Use a glass rod for stirring and keep good workshop tools away from acids, or for that matter, any of the chemicals used for battery making.

ACID INTO WATER .

Sulphuric acid must always be poured into the water when mixing. There is heat generated so pour slowly and allow time to cool. If water is poured on acid, the heat generated may cause an explosion.

It is a good idea to consult your science teacher or an experienced friend about these matters if you are not sure. As well as helpful advice, your teacher may be willing to let you have small quantities of the chemicals and save you the expense of buying them.

Although we did not try them, similar results can be obtained with other acids.

In the combinations of plates we tried, you will note that carbon and zinc gave the highest voltages, and it is these two substances which are nowadays used in most primary batteries. Ordinary torch cells are fundamentally similar to the cells we have been experimenting with, and have a positive electrode of carbon and a negative electrode of zinc. The electrolyte is different from the simple cells in order to overcome the defects we are about to discuss.

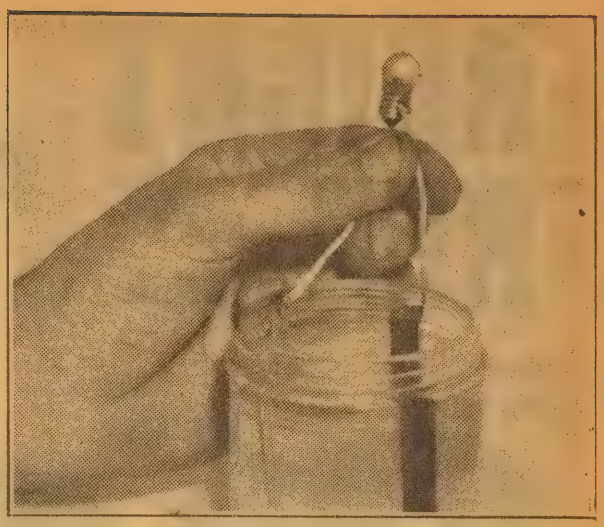
The simple cell made with carbon and zinc when freshly made will light a small torch globe or operate a sensitive electric bell. However, it will do so for only a few seconds and then its electric power seems to disappear. If you pull the plates out of the electrolyte and wipe them dry and try connecting the circuit the same thing will happen again.

The cause of the trouble is hydrogen gas which is generated by a chemical action within the cell and which collects in the form of tiny bubbles on the positive plate until they almost completely cover it. This hydrogen gas prevents the flow of the electric current and so makes the cell useless. The phenomenon is known as polarisation and all simple cells suffer from the same defect.

☆

With a carbon rod from a worn out torch cell and a scrap of zinc dipped in a dilute sulphuric solution, sufficient current will be generated to light a small torch globe.

☆



RESULTS OF TESTS

Ammonium Chloride Electrolyte

Position Element	Negative Element	Voltage
Carbon	Zinc	1.1
Carbon	Aluminium	.9
Carbon	Copper	.3
Copper	Zinc	.7
Copper	Aluminium	.65
Aluminium	Zinc	.1

10 pc Sulphuric Acid Solution

Carbon	Zinc	1.6
Carbon	Aluminum	1.2
Carbon	Copper	.5
Copper	Zinc	.9
Copper	Aluminium	.8
Aluminium	Zinc	.4

Before the modern chemical methods of preventing polarisation were discovered people tried various other means which seem very peculiar nowadays. Some schemes involved the use of a clockwork mechanism to shake the bubbles. In one arrangement a clockwork motor was used to turn a carbon wheel which was used as the positive plate of the cell. Only half the wheel was dipped in the electlyte at the one time. As it revolved and the top half was exposed to air, the hydrogen disappeared.

However, none of these schemes was very efficient or convenient, and really useful cells could not be made until a method of chemical depolarisation was discovered.

Other chemicals have been used but modern cells use a chemical called maganese dioxide. It is a black powder and looks like soot. In electric cells its useful property is that it will combine chemically with the hydrogen gas causing the latter to disappear. The properties of the new substances formed by the chemical reaction between the manganese dioxide and the hydrogen do not have the same detrimental effects.

Unfortunately, manganese dioxide is not a particularly good conductor of electricity. Powdered carbon is usually mixed with it in order to lower its resistance.

HOME-MADE CELL

As a matter of interest, we made up a cell using an electrolyte of ammonium chloride and zinc and carbon elements. The carbon element was packed in a plastic container with (and entirely surrounded by) an equal mixture of powdered carbon and manganese dioxide. A little of the liquid electrolyte was added to the mixture to moisten it and to improve its conductivity.

The traditional way of doing this is to pack the carbon element and the depolarising mix in a porous pot. Something after the style of an unglazed flower pot would be suitable, although the smallest flower pot you are likely to be able to obtain would make a very large cell. The purpose of the container is merely to hold the depolarising mixture.

In our case, we obtained a 1¼in diameter plastic coil former and with a 1-16in diameter drill, made as many holes in it as possible without weakening it too much mechanically. The manganese dioxide and powdered carbon were mixed together thoroughly and a little of the ammonium chloride solution added to make a damp paste.

With a carbon rod taken from an old dry cell held in the centre of the container, the depolarising mixture was pressed in around the carbon rod. The idea is to pack the mixture as tightly as possible without breaking the container.

On test, the cell showed itself capable of delivering a small current for a considerable period of time.

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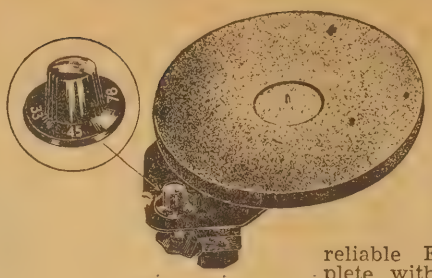

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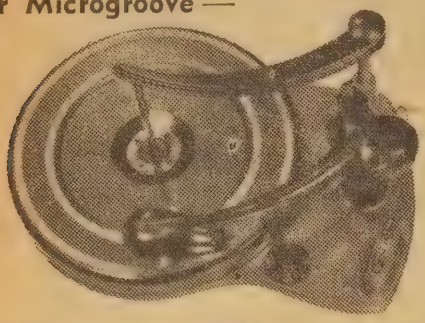

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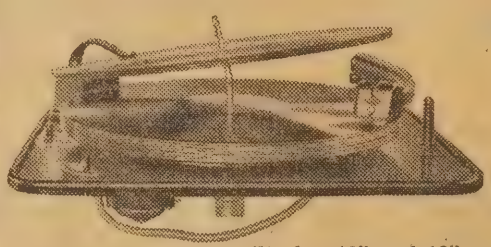

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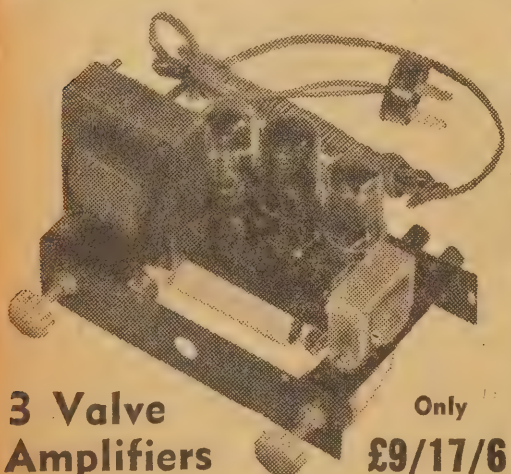

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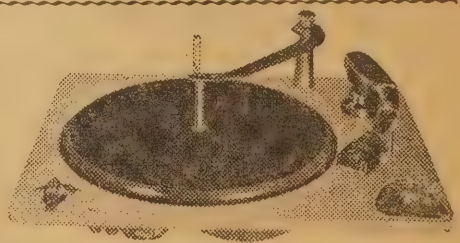

COLLARO 3 speed Automatic Record Changer Model 3RC511

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Pre-set speed regulator and record size to play 9 x 7" or 9 x 10" or 9 x 12" discs.

MAXWELL'S RADIO

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The maximum current was limited, possibly by the relatively small area of the depolarising mixture in contact with the electrolyte, despite the fact that there were as many holes in the plastic container as could safely be made.

The important feature of this type of cell is that it is capable of delivering its small amount of current over a long period of time.

It appears that the depolarising mixture is fairly slow in its action so that, if the cell is given a heavy discharge, its voltage will drop but, if it is then allowed to stand for a time, it will return almost to normal.

Credit for the development of the improved primary cell must be given to a man called Leclanche. He developed a cell very similar to the one we have been discussing in 1868.

You can buy the parts for the traditional Leclanche cells at scientific supply stores and they are frequently to be found in school science laboratories.

Usually they consist of a jar capable of holding about 3 pints. Inside this is a porous pot about 2in in diameter and inside this again is a carbon rod about ½in diameter. The space between the rod and the pot is packed with the manganese dioxide and carbon mixture and

DRY CELL MIXTURES

1st Mixture

Ammonium Chloride	1 part
Zinc Chloride	1 part
Plaster of Paris	1 part
Flour	1 part
Water	2 parts

2nd Mixture

Ammonium Chloride	1 part
Zinc Chloride	1 part
Flour	1 part
Manganese Dioxide	3 parts
Powdered Carbon	1 part
Water	3 parts

lowered into the jar. The jar is then filled with the electrolyte solution in which a zinc rod about ½in diameter is placed.

Ammonium chloride is used for the electrolyte solution rather than sulphuric acid because it does not chemically attack the zinc so rapidly.

Leclanche cell has a nominal unloaded pressure of 1.55 volts although, with specially prepared manganese dioxide, it is possible to obtain up to 1.75 volts. The size of the cell does not affect the voltage but it does govern the amount of current which the cell is capable of delivering and, of course, its internal resistance.

After a small amount of use the voltage of the cell drops to about 1.4 and remains at this figure for the greater part of its working life. For this reason many battery-operated valves are designed to work with a nominal 1.4 volts applied to the filaments.

In its original form the Leclanche cell is very useful for applications which require small currents or currents for only a short time such as would be required for ringing an electric bell or buzzer. The fact that it is bulky and that it requires a liquid electrolyte makes it very inconvenient where portability is required.

The next development was the dry cell as it is so called. Actually, in all cases the electrolyte is damp paste or a jelly. The first successful dry cell was constructed by a man named Gassnar in 1888.

Everybody is familiar with the modern dry cell. It is a direct development of the original Leclanche cell. The positive pole is a carbon rod. This is packed in a manganese dioxide/carbon depolarising mixture which is, in turn, surrounded by an electrolyte consisting of ammonium chloride mixed with a small amount of water and other substances which go to make up damp paste. This is placed in a zinc can which acts as the negative pole of the cell as well as a container.

Nowadays, the making of dry cells is a major industry. They have hundreds of applications from electric torches to portable radios and are made in dozens of different shapes and sizes to suit the particular application. Large battery manufacturers maintain laboratories which are able to test the quality of the chemicals and decide the exact proportions of each which is to go into a cell for a particular application.

SPECIAL FORMULAS

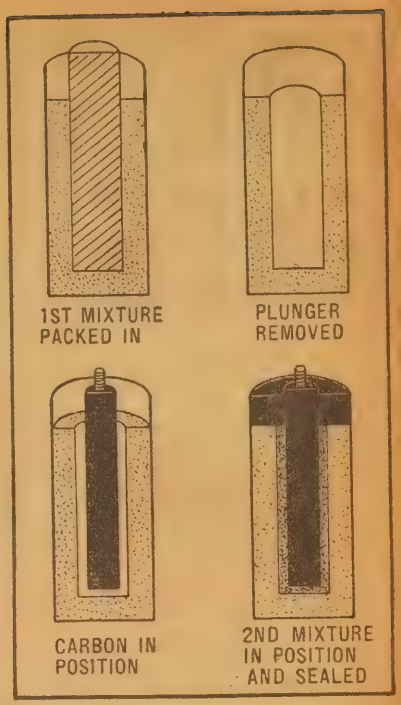
Manufacturers who have spent time and money in developing a formula for an efficient dry cell are not always willing to make it public so that the exact formulae used for commercial cells remain largely a secret.

Different formulae are required for different applications. Sometimes a compromise must be reached between the amount of current the cell is capable of delivering and the time it is capable of standing unused without deterioration.

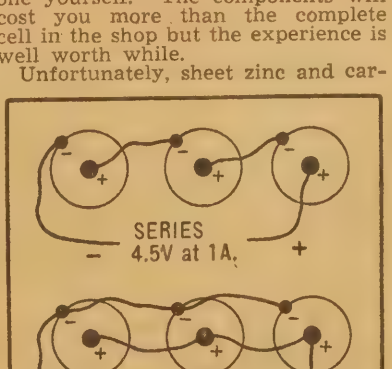
For example, a manufacturer supplying a local market may use a different formula to a manufacturer whose products are to be shipped overseas where the cells may not be put into operation for some time. Cells which are required only to supply a potential difference for bias purposes use a different formula again.

While you cannot hope to compete with the efficiency of a commercial dry cell you may like to try making one yourself. The components will cost you more than the complete cell in the shop but the experience is well worth while.

Unfortunately, sheet zinc and carbon rods are very difficult to obtain and the best approach appears to be to salvage these from a dry cell which has served its useful life in the normal way. The carbon rod will not have deteriorated in any way and, if the cell has not been allowed to stand for too long, the zinc can should be in reasonably good condition.



Here are the steps in making a dry cell. Formulas for the 1st mixture (electrolyte) and 2nd mixture (depolariser) are given in the table.



Cells may be connected together to form a battery which can deliver more power than a single cell. The top diagram shows a series connection of three cells, each of which can deliver 1.5V at 1A. They can deliver 4.5V at 1A. If connected in parallel they can deliver 1.5V at 3A. In each case the amount of power is the same.

PREPARING CAN

Remove the electrolyte and the depolarising mixture and clean the carbon rod and the zinc can. It will probably be necessary to use emery cloth to remove all traces of the chemical reaction from the inside of the can.

The first mixture shown in the table is the electrolyte. It makes up into a white paste which can be poured quite easily at first but after a few minutes it sets fairly hard. The inside of the can should be lined with the electrolyte while it is still able to be poured easily.

You may be able to use a wooden dowel to assist in obtaining an even distribution over the inside surface, including the bottom. The layer of electrolyte should be thick enough to prevent any possibility of the depolarising mixture touching the zinc can, and so causing a short-circuit within the cell.

The carbon for the depolarising mixture can be obtained by breaking up carbon rods from old batteries with a hammer. Better still hold them against a grinding wheel and collect the powder.

The depolarising mixture makes up into a stiff black powder which should be packed in between the carbon rod and the electrolyte as shown in the diagram.

A cell constructed as described from torch cell components will deliver about 1.4 volts and a current up to about 100 milliamperes.

Let's Buy An Argument

Faced with writing a regular article like "Let's Buy An Argument" one rapidly acquires the habit of scribbling ideas on scraps of paper and dropping them into a folder. Sooner or later the folder becomes so bulky that you either throw all the pieces of paper away or, alternatively, you decide doggedly to make use of them. I propose, this month, to follow the latter course.

by W. N. Williams

THE first piece of paper I pick up merely carries the words "diode distortion." (see Wireless World for May, 1951).

I know that's a flagrant adv. for a contemporary journal, but one would need to be hopelessly insular to ignore (or pretend to ignore) the wealth of excellent technical material now available.

The subject of diode detector distortion is one which crops up every now and again—especially when someone snootily remarks, "Of course I'm using a reflex detector to avoid distortion . . ."

THEY ALL DISTORT

We may as well get it straight that every detector, along with every other device or circuit we may employ, does introduce a measure of distortion. The question is how much?

If it can be shown that the distortion in a device is truly negligible from the listener's point of view, then it is reasonable to consider other factors like that of cheapness and convenience. And there is no doubt that the diode scores heavily on both counts.

As far as I personally am concerned I'm neither agin reflex detectors or for diodes. If diodes seem to be favored in R. and H. designs, it's only because we have generally reckoned that the arguments, overall, come out in their favor. If you assess the pros and cons differently, good luck to you. Or am I being too placatory for an article of this nature?

Some of the criticism levelled at diode circuits in the past has certainly been justified. Perhaps I should be more realistic and sheet home the blame on those designers who have perpetrated the associated circuits.

The story, in brief, is illustrated by figure 1. It will be apparent that an essential part of a diode circuit is the load resistor across which the signal voltage is developed. We have branded it "Rdc" in figure 1a, because it is, in fact, the DC load of the diode detector.

With ordinary diodes, its value can be as high as about 1.0 megohm, and as low as about 0.1 or 0.2. High values are more susceptible to treble-loss troubles from capacitive bypassing, while very low values are undesirable because detector linearity and efficiency may suffer.

SHUNT LOADING

In the process of picking up the signal from across the diode load, a certain amount of shunt loading is introduced, and this is undesirable. It is generally accepted that the detector will only be able to handle without distortion depths of modulation equivalent to the radio between the AC and DC load.

If, for example, the AC load happens to be 0.18 meg and the DC load is 0.2 meg, then the peak modulation capacity without distortion is commonly said to be 90 pc.

Now I have seen plenty of sets where this elementary requirement has been completely ignored by the designer. I have seen them with the circuit of figure 1b, where the 0.5 meg. DC load is shunted by a 0.5 meg. volume control and by a 0.5 meg. AVC decoupling resistor.

The AC loading in this case is the resultant of all three half megs. in parallel, giving a figure of 0.16 meg. Compared with the DC load of 0.5 meg., this would indicate a peak modulation capacity of 33 pc. For such a figure I could never dare to make excuses.

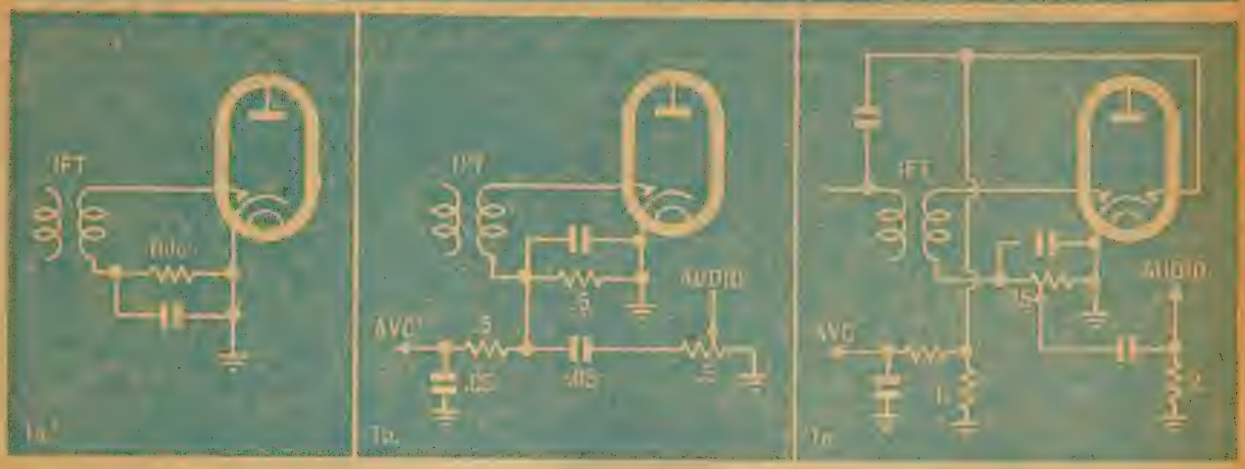
Fortunately, it is not typical.

The preferred arrangement of figure 1c begins by isolating the AVC circuit altogether—or substantially so, by using a separate diode and separate RF feed.

Then the DC load is kept to a minimum value and made to serve as the volume control. The following grid resistor is kept high in value and connected, anyway, across only as much of the volume control as happens to be in circuit. It isn't hard by such means to push the AC/DC ratio up to well over the 90 pc previously mentioned.

In the issue of Wireless World

FACTORS GOVERNING PERFORMANCE OF DIODES



Showing the elementary diode circuit (1a), how a diode should NOT be used (1b) and a properly designed circuit (1c) where distortion is not likely to be apparent on heavily modulated signals.

that I mentioned, our well informed friend, W. T. Cocking, points out the figure of modulation thus calculated should really be applied to the signal effective at the diode. Further, that the signal at the diode is less heavily modulated than the signal arriving at the aerial.

How this comes about involves a column of maths., but it is due, fundamentally, to the fact that a diode presents a lower impedance to a changing RF input than one which is constant. This is reflected back as a changing load on the IF transformer and amplifier so that the ultimate calculation takes in factors like plate impedance of the IF stage and the transformer coupling factor.

By way of illustration Cocking takes a mediocre diode circuit and shows that the AC/DC load ratio would apparently impose a limitation on distortion-free detection equal to 73 pc—not a very commendable figure.

By taking into consideration the modulation fall in the IF stage and output coupling, the figure of 73 pc is pushed up to 82 pc, representing quite a notable increase.

If one takes an optimum type of circuit, as in figure 1c and makes due allowance for the abovementioned effect, the AC/DC load ratio would seem to disappear altogether as a problem.

IT MIGHT BE

Which prompts me to make a remark aside (sotto voce). I have frequently heard it said that the signal from the powerful national stations is cleaner than the signal from B class stations, because the national stations use a lower average modulation level.

It could be that the peak limiters on the national stations have less work to do.

Or it could be that a lot of receivers just can't take heavily modulated signals without cracking up?

The ball's in your court, dear reader.

The next slip of paper I find in the folio contains an extract from a letter, carried over from earlier discussion on practical amplifier design.

It reads as follows:—

The estimates for the limits of hearing are mostly much too low, I personally put the limit around 30 Kc/sec. The frequency response of all links in the reproducing chain should extend to well over this figure, since the response droops before its limit, and hence at the limit the response is usually well down. So, to get a response plus or minus ½ db to 30 Kc, we have to design rather on the basis of plus or minus 5 db at 35 Kc. (W.G.S. B.Sc., Punchbowl, NSW.)

This letter, I might say, was not by any means an isolated case, and I was left wondering about the reason for querying frequency limits.

To be sure, it has been suggested that our senses are responsive in some obscure way to extremely high frequency transients, but, to the best of my knowledge, as far as musical values are concerned, it is all mere unproven speculation.

LET'S BE PRACTICAL

It is equally certain that such transients do not get through any available programme channel, and the point in designing an amplifier to handle what isn't there is rather obscure!

However, to come back to known grounds, I have personally checked dozens of people for their top limit of hearing — anyone, in fact, who happens to walk in when audio tests are in progress.

Fortunately, for my own peace of mind, the observations correspond with the findings of others who have conducted similar tests.

The average top limit—or should I say the most frequently observed top limit—is around the 15 Kc. mark. The lowest I have tested recently is about 11½ Kc. and the highest just on 19 Kc. but both these are exceptional cases.

It is interesting to note, also, that the limit is quite sharply defined in most people. By using a lot of power or more efficient speakers, one can hear above the normal limit by sheer brute force, but there is a limit even to this.

As far as I personally am concerned, I can hear quite well at 15 Kc., but am virtually deaf at 16 Kc. My response curve appears to roll over very sharply at between the two figures.

Moreover, it appears to be fairly constant, in that repeat twiddling of the generator dial, with eyes closed, always brings up the same limit setting of 15½ Kc.

Much the same remarks go for other people who have been the "victim" of similar tests over the years.

FORM OF TORTURE

Leaving the equipment running at a frequency just beyond audibility seems to induce a tight feeling in the head, with definite signs of nervous strain and irritability, even after a few minutes. Switch the amplifier off and you can feel immediately the sense of relaxation.

In other words, we do apparently react to sustained tones above the fringe of audibility, but I doubt whether such feelings can be classed as a musical reaction to "sound."

While on the subject of sound, I notice another extract from a letter which is worth reprinting.

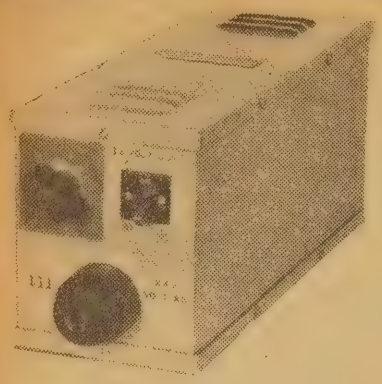
The correspondent obviously imagines, as do many others, that deafness is a simple loss of sensitivity and all that is required is an amplifier to bring it back to normal.

Now I'm not an expert in hearing aid design but I do know that

DESIGN OF DEAF AIDS

It always puzzles me why a magazine like "Radio and Hobbies" is so slow to design a simple deaf aid unit for its afflicted readers. I know there might be difficulties about making a very small unit but that would be less important than saving a lot of money.

I can't see any special difficulty about the idea. Surely it is simply a matter of getting a suitable mike and earphone and putting a small amplifier between the two. The gain could be set as high as necessary to bring the hearing back to normal sensitivity.



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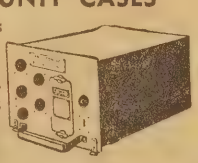

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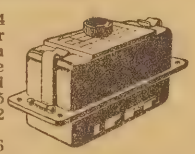

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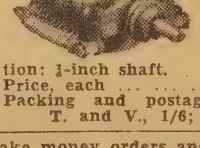

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there's often a lot more to the problem than this.

It might be satisfactory to regard some cases simply as lowered sensitivity but there are plenty of others where the problem is much more complex.

Quite commonly, the loss of sensitivity is only in respect to the weaker sounds, like room background noise and quiet conversation. When it comes to loud sounds, the hearing more or less suddenly "comes good" and the person thus afflicted hears them at near-normal intensity.

What is more, extremely loud sounds readily produce sensations of pain and, in fact, the person with defective hearing may be unusually sensitive in this regard.

It means, in effect, that the dynamic range of their hearing is severely restricted.

HEARING CURVES

Reverting to a rather classic set of curves originating from the Bell Telephone Labs., it will be seen that the threshold of normal hearing at 1000 cps is represented as zero decibels. The threshold of pain at the same frequency is shown as 120 db and this represents the dynamic range of the ear under ideal conditions.

Normal music and speech fall well inside these two extremes, as indicated.

Let's say, however, that a person suffers an initial hearing loss of 50 db. According to the curve, they would be losing out quite markedly on everyday noises, quiet music and quiet speech. They would be very definitely "hard of hearing."

To bring their hearing right back to normal, it would be necessary to provide a full 50 db of gain in a hearing aid. But, alas, this many db of gain, piled on top of loud speech or music (for which their hearing is fairly normal) would carry the peaks well up into the "pain" region.

Immediately one is faced with the need for a compromise. The gain necessary to cover the full range of quiet sounds may produce distress on loud peaks. However, a figure of gain, which avoids distress on peaks, may not adequately bridge the zone of silence.

So the patient either finds a setting which makes the best of things, or fiddles frequently with the gain control, or longs for a hearing aid fitted with AVC.

OTHER CASES

Fortunately, as I said earlier, not all patients are thus afflicted—it all depends on where in the ear the weakness lies. In some cases, the aural obstruction acts just like a flat, attenuating pad with losses ranging even as high as 80 or 90 db. The threshold of pain is not a problem in such cases.

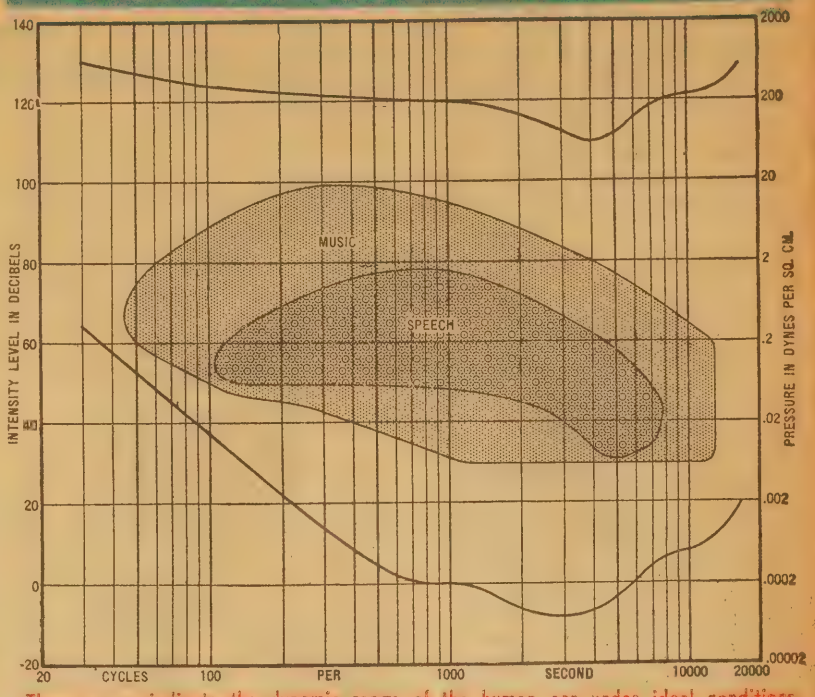
Yet, in the other extreme, are cases where the dynamic range is so restricted that the patients are sensitive to volume changes as little as 0.2 db. The average person is battling to pick a change in level of 1.0 db!

Then there's the matter of frequency response. Deafness may not be evenly distributed over the whole spectrum but may need assistance in, say, the treble register only. Too much gain at the bass end may merely turn the world of sound into a world of "woofs."

Firms which specialise in hearing aids commonly take the response curves, in addition to establishing for each patient the limits of their dynamic range.

Last but not least is a point which I consider most important, namely, that hearing aids give assistance to one ear only, leaving the other to battle on alone. The user gets a monaural version only of what goes on.

CURVES OF SOUND INTENSITY



These curves indicate the dynamic range of the human ear under ideal conditions and the range commonly involved by speech and music. Loss of dynamic range produces special difficulties.

CANNOT DISCRIMINATE

This largely robs them of a sense of direction for sound and leaves them completely at the mercy of noise and reverberation effects which a person with two normal ears can largely reject.

If you want a simple illustration of this, try blocking one ear in a noisy cafe, whlie trying to carry on a conversation. See how much more difficult it is to concentrate on what you want to hear.

The deaf person who puts on a hearing aid for the first time may therefore face several problems:

(1) Instead of a peaceful world of silence, to which they've become accustomed, they are suddenly launched into a babel of sound, much of it apparently so unnecessary and confusing.

(2) The sound generally lacks direction, because one ear is now working far more efficiently than the other.

(3) They hear room echoes but cannot reject them, as the average person does quite automatically. They have to develop a new sense of concentration with only one ear working.

(4) If the deafness involves severely restricted dynamic range, they may have to anticipate quiet and noisy sounds and adjust the hearing aid accordingly.

It all adds up to an interesting problem involving psychological as well as mere technical considerations. Things like bulk, visibility and running costs have to be considered, too.

If a reasonable balance is not struck and the subject forewarned as to what to expect, they are likely to cast the thing aside as an "invention of the devil."

Just in case I've given the wrong impression, don't run away with the idea that I'm against hearing aids or think they can't be made to work. What I am saying is that there's a lot more to them than a circuit and a handful of radio bits.

The real art in making a hearing aid—apart from prescribing for the particular aural defect—is that of compressing parts and circuitry into pocket-book dimensions. Some of the tiny parts aren't even available, as far as I know, on the open market.

I've often thought, however, that there might be a future in a table model hearing aid to use in the home and operating from the mains at virtually no cost. I've even toyed with the idea of a binaural table model with two microphones and amplifiers coupled to separate headphones. I wonder would it be welcome?

Come to think of it, there might easily be room for helpful discussion around the subject. What do you say?

HOW TO RE-CONDITION MAGNETS

THE hundred-and-one magnets that are used in various pieces of apparatus are liable, through knocks and jars, and by the passage of time, to lose their magnetism. The fact that some of the magnetism is lost may not be appreciated, and in the case of a loudspeaker, for example, the increased efficiency and "attack" of a perfectly functioning magnet is most pronounced.

The method of remagnetising adopted by the amateur often works on the hit or miss principle. This is to wind some few turns of stout wire around the magnet or polepieces and pass a heavy current through the wire from a 6-volt or 12-volt accumulator. If the wire has a resistance of a quarter of an ohm, the current in the latter case will rise to 48 amperes for a brief period, and supposing there are 20 turns of wire, this will give nearly 1000 ampere turns—which is quite sufficient to induce an intense magnetism in most magnets, including those of loudspeakers.

The poor results which follow this treatment, however, are often inexplicable to the layman. The magnet may be in worse condition than before. This is due to a very simple fact; the lines of force in rising create magnetism of one polarity, and on collapsing magnetism of the opposite polarity. Thus, even though the magnet be sufficiently magnetised in the correct polarity, some of the magnetism is taken away when the lines of force collapse.

It will be appreciated, therefore, that remagnetising cannot be efficiently carried out by this means. Commercial practice includes the use of a high intensity current lasting a short time, with a non-return valve incorporated. Thus a pulse of 1000 amperes lasting a fraction of a second through a one-turn coil imparts the magnetism to loudspeakers. The writer has developed a technique which achieves the same result and which is not elaborate and costly.

PRACTICAL DATA

The scheme makes use of a rotary transformer supplying a DC output of about 6 volts, 5 amperes, in addition, a 6-volt accumulator is used in the manner to be described.

First wind about 20 turns of No. 18 s.w.g. wire around the polepiece of the loudspeaker magnet. Connect the ends to the output of the rotary transformer and noting which way round the magnet becomes stronger, and which is positive and which is negative. The machine will probably run rather slower than usual, due to the fact that the low resistance of the coil is directly across its terminals. Its voltage output will probably be lower and the current somewhat higher.

Now, still keeping the coil across the terminals of the rotary transformer, connect for a brief instant a 6-volt accumulator to the terminals in the correct polarity—positive to positive, &c. The current from the accumulator will be split into two parts, i.e. through the low voltage winding of the rotary transformer, and also through the remagnetising coil. The effect of the first will be to speed up the machine slightly, but the second and major portion of the current will flow through the coil.

Thus, if the coil has a resistance of 1/10th ohm, 60 amperes will flow through the coil for a brief period, which will give over 1000 ampere turns in the coil. As soon as this happens the accumulator can be disconnected, the rotary transformer being left running. Finally, switch off the rotary transformer at the high tension side and the machine will come to a stop with the cessation of all current.

If correctly performed this procedure will ensure a high flux density in the magnet without the demagnetising effect of the collapsing lines of force.

The procedure is usually applicable to other magnets than those of loudspeakers, but in the case of small magnets the gauge of wire in the coil should be appropriately modified.

MAGIC EYE TUNING INDICATORS

We are frequently asked, through the query service, about magic eye tuning indicators—what they are, how they work and how they may be connected to an existing set. If you want to know the answers to these questions, read through this article

By RAYMOND HOWE

THE first part of the question may be answered very simply: A "magic eye" is, in reality, a miniature cathode-ray valve which helps you tune your set accurately to the desired station.

One may well ask what is the use of a visual tuning indicator when a good pair of ears can do the same thing. That, of course, is just the point. A pair of ears may perform well enough normally, but they often fail lamentably to locate the true tuning position of a station.

Modern receivers, with their effective automatic volume control system, tend to mask the exact centre of the station's channel and it becomes necessary to be guided by the "tone" of the pragram, rather than the volume. One has to listen for the spot where the reproduction is deepest in quality, with a minimum of background "swish."

Not all listeners understand this, but tune, instead, to one side of a station, then make up for any lack of volume by turning up the volume control. The result is a program lacking in bass, but over-supplied with high-frequencies—and distortion!

A "Magic Eye," however, will readily show the strength of the station received irrespective of the volume of sound coming from the speaker. In fact, you can tune the set in complete silence, then turn up the volume as desired.

While there are other ways of tackling the problem, such as by push-button tuning or "automatic frequency control," the "Magic Eye" is the simplest method.

The highbrow term for the device is "electron-ray tuning indicator" or "cathode-ray tuning indicator." Although not very complicated, it can be said that "there is more to it than meets the eye."

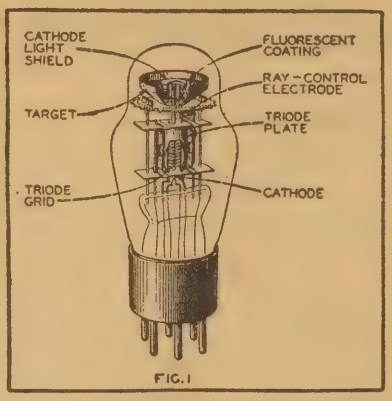
THE "WORKS"

Fig. 1 gives a picture of what is inside the glass envelope. Working from the inside out, the heater wires are inside the cathode sleeve, as in the conventional valve. Around the cathode sleeve is the control grid whilst around this grid is a plate (or anode). One can readily see that this combination makes up a simple triode structure.

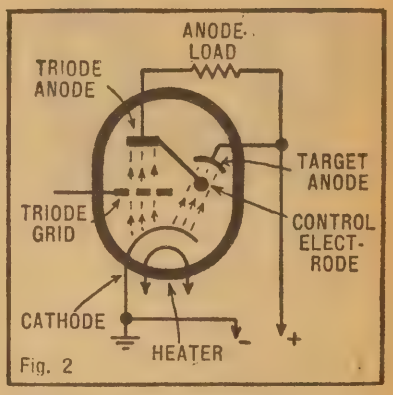
However, this is only half the story. Above the triode is a "target anode," shaped like an inverted cone. Its inside face is coated with a fluorescent material, much the same as the screen of the familiar cathode-ray tube.

The cathode sleeve is common to both the triode structure and target anode.

The remaining electrode in the electron ray portion of the indicator is the ray control electrode. This is a metal blade which is located between the cathode sleeve and the target anode and is connected internally to the triode anode. A metal cap fits over the end of the cathode sleeve to block the direct light from the heater.



A line sketch showing the essential features of an indicator of the 6E5 or 6G5 variety. Other indicators have different bases and bulb shape but the operating principle remains the same.



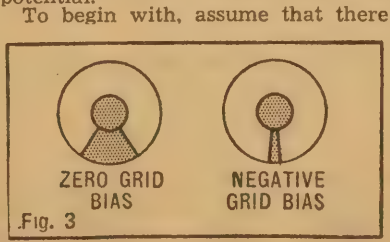
Illustrating the operation of a tuning indicator. The controlling bias is fed to the grid of a triode section. A vane, connected internally to the triode plate controls the shadow angle.

Electrons from the cathode strike the target anode and cause the fluorescent material to glow. It is not difficult to visualise that, if some of these electrons are prevented from hitting the target anode, a portion of the screen will not glow or, to put it another way, it will be in shadow.

CIRCUIT DIAGRAM

Fig. 2 shows the schematic diagram of a tuning indicator. For the purposes of illustration, the cathode is shown as being grounded. The triode anode is connected to high tension through its own load resistor, whilst the target anode is connected directly to high tension. Note that the ray control electrode is connected internally to the triode plate and, as a result, will have the same potential.

To begin with, assume that there is no bias applied to the grid of the triode. Current will flow through the triode portion and produce a voltage drop across the anode and the load resistor. As a result the triode anode will be less positive than the target anode, and, since the ray control electrode is connected to the triode anode, it also will be less positive (i.e. negative) with respect to the target anode.



The shadow angle varies from 90-degrees open with no bias — therefore no signal—to fully closed with an input signal and high bias.

SHADOW APPEARS

Under these conditions the ray control will deflect some of the electrons flowing from the cathode to the target and will cause a shadow to appear.

Conversely the grid of the triode portion may be supplied with a high negative bias sufficient to cut off substantially the current flow in this section. With no current flow there will be little or no voltage drop across the triode anode load resistor and the triode anode and hence the ray control electrode will be at much the same potential as the target anode.

This means that the control electrode will not deflect any of the electrons passing from the cathode to the target anode and the whole of the screen will be aglow.

In other words there will be no shadow.

For intermediate values of bias and current flow through the triode portion the shadow angle will vary accordingly.

The position of the ray control electrode is normally arranged to produce a maximum shadow angle of about 90 degrees.

That's the broad outline of the basic operation. Some tubes include two (or even more) ray control electrodes to give shadows on opposite portions

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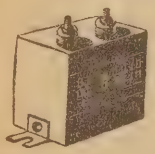

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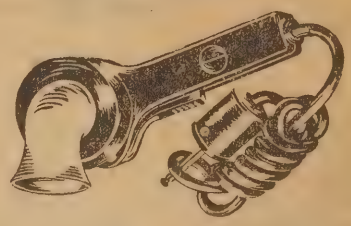

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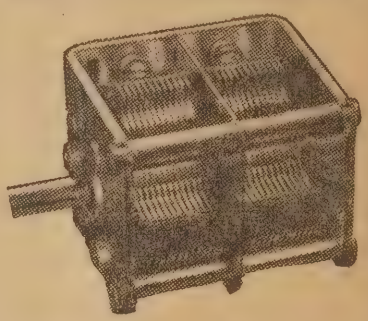

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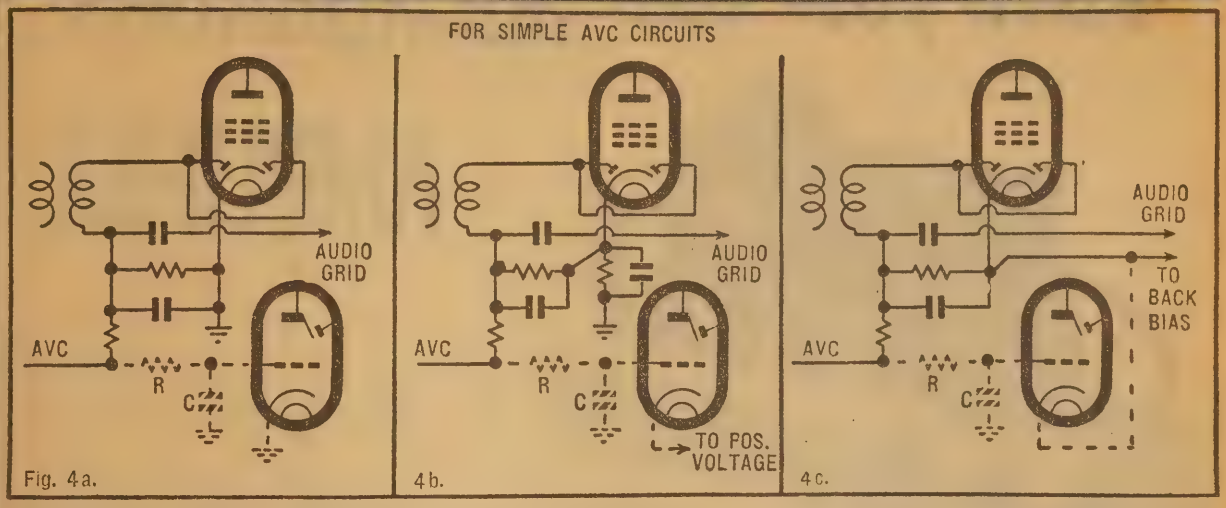


Showing how the magic eye may be wired into receivers employing simple AVC. Object is to place the cathode at the same potential as the diode load return point, so that there is no initial bias applied to the indicator grid. Such initial bias may prevent shadow from opening fully with no signal input.

of the screen. Others have remote cut-off characteristics for the triode portion to give indication over a wide range of control grid voltage, while in special twin tubes two triode structures with their own ray control electrodes give independent shadows on the same screen.

Still another type is the twin indicator without the triode elements, the two ray control electrodes being brought out through a couple of pins on the base of the envelope for external control. All these types are relatively rare, however.

Of the well-known types the 6E5 has a sharp cut-off characteristic and a bias of minus 8 volts will give a shadow angle of zero degrees.

In contrast, the 6U5/6G5 is a remote cut-off type and requires minus 22 volts for a shadow angle of zero degrees. This special characteristic of the triode section provides adequate sensitivity for weak signals and yet prevents undue overlapping at the edges of the shadow on strong signals.

Most of the tuning indicators which have appeared on the local market resemble the 6E5 or the 6U5/6G5, the difference being mainly physical—basing, envelope shape, &c. With some the recommended value of triode anode load is 2 megohms, while with others it is 1 megohm. Such data is given in any valve data book.

CONNECTIONS

To place the device into operation in a modern receiver it will readily appear that all that is required is to connect the heater to the existing heater circuit, supply the triode anode and the target anode with HT in the appropriate manner and connect the grid to a negative bias which will vary with the strength of the station.

Obvious source of the negative bias would be the AVC line or the "hot" end of the load resistor of a diode detector.

If your set has no AVC (automatic volume cotrol) there is little point in worrying about a magic eye at all since you can tune, quite easily, for the loudest signal.

Usually, however, a set will have AVC of one type or another.

With "simple AVC" the one diode is common to both the detector and the AVC circuit. Additional shunting of the detector diode load resistor by the indicator grid circuit can be avoided by connecting the indicator grid to the AVC line at a point after the AVC isolating resistor. The accompanying circuits show where this point is.

The grid could actually be tied directly to the AVC line, although a couple of minor objections might be raised. If the AVC line is not completely "dead" for RF, a long, attached lead running around the chassis might just promote instability. Furthermore, if the low-frequency audio components are not completely filtered from the line, they can produce a slight flicker in the shadow edges.

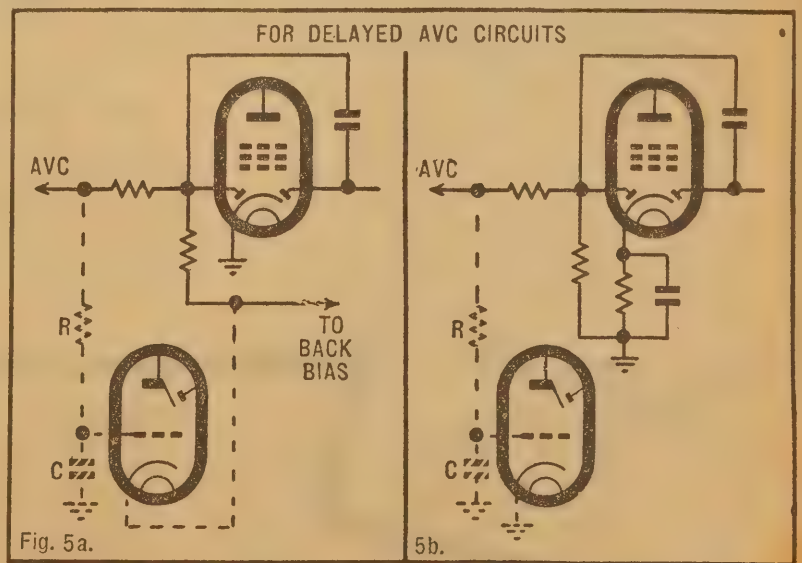
It is usual, therefore, to specify some decoupling for the indicator grid, typical valves being a 1-meg. resistor and a .05 mfd. condenser. If the components are made larger than this, the operation of the eye is likely to be sluggish. It may even be necessary in some sets to use lower value components or omit them altogether in the interests of more precise indication.

With "delayed AVC" the negative voltage for the automatic volume control is provided by a separate diode. The "delay" bias for the diode is obtained either by returning its load resistor to a point in a back-bias network or to earth if the diode cathode is "cathode biased."

WEAK STATIONS

Connecting the indicator grid to a "delayed" AVC line means that the indicator shadow will not move when tuning stations which are not strong enough to overcome the "delay" bias.

This normally doesn't matter a great deal, because such stations can



Showing how the eye is installed in receivers having separate or delayed AVC circuits. Object in this case is to have the tuning indicator cathode at the same potential as the AVC load return point, which is nearly always to earth or to the back-bias line.

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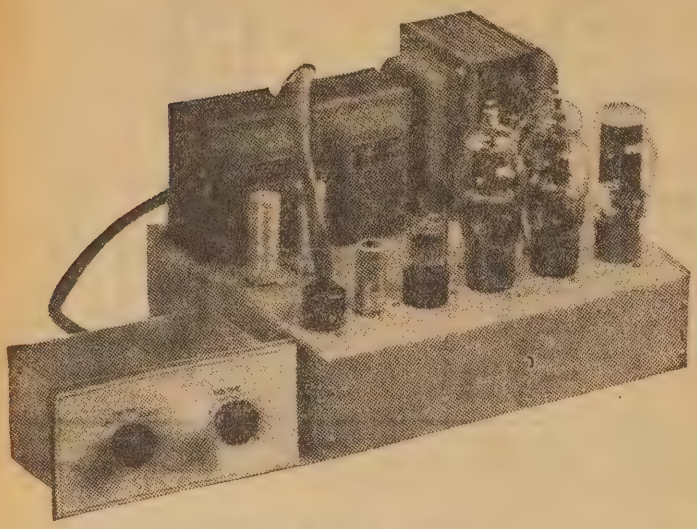

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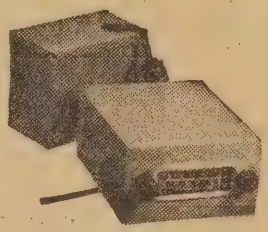

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be tuned for the loudest setting. It is the strong locals which cause the difficulty. However, if you do not desire any "delay" on the operation of the indicator shadow, it will be necessary to connect the indicator grid to the detector diode load, as already mentioned. You must make up your own mind on this point.

The next consideration is what to do with the cathode of the indicator. Ideally, it should be at the same initial potential as the point to which the grid is connected in either the simple or delayed AVC circuits.

If you are operating the "eye" from the detector circuit and the cathode of the diode happens to be connected direct to earth, the indicator cathode will also connect to earth. (Fig. 4a.)

On the other hand, if the diode cathode is biased with the resistor, the indicator cathode will also require a positive potential. (Fig. 4b.)

NEGATIVE RETURN

In some receivers, the diode cathode and diode load return to a negative point in a back-bias network. In this case, the cathode of the indicator should also be connected to the same negative point. (Fig. 4c.) As the full current drain of the set flows through the back-bias resistor the comparatively small additional current of the indicator cathode will not materially affect the condition at that point.

For delayed AVC circuits, figs. 5a and 5b apply.

To place the indicator cathode positive, as required by the previously mentioned conditions, a suitable method is to "tap into" in the cathode resistor of the power output stage, so that the required positive voltage is obtained.

For instance, with a 6V6-GT, where the normal cathode resistor value is 250 ohms for 250 volts plate and screen operation, a series combination of a 200 ohm and a 50 ohm would provide a tapping point where the voltage would be about 2.5 volts positive with respect to earth.

In the case of a duo-diode pentode valve where the pentode portion is used as an IF amplifier, the pentode cathode will normally be provided with a minimum voltage of about three volts. The 0.5 volt difference between the two figures will be of little consequence.

Where the duo-diode pentode or triode valve has the pentode or triode portion functioning as an audio voltage amplifier and the common cathode of this valve is biased with a resistor, the cathode will be positive by about 1 to 1.5 volts.

POSITIVE CATHODE

Ideally the tapping in the output pentode cathode resistor for the biasing of the indicator cathode should be rearranged so that that point is about one volt positive with respect to ground. This would call for a combination of resistors of values of 230 ohms and 20 ohms, but these are awkward values, to say the least, and it may be easier simply to connect a 25-ohm resistor in series with the present bias resistor.

If under these conditions the 250 ohm and 50 ohm resistors were used to give a 2.5 volt positive bias to the indicator cathode it would merely mean that the "off-tune" angle of the shadow would be something less than 90 degrees.

It is, of course, possible to cathode bias the indicator itself so that the cathode reaches the required positive potential. The actual value of resistor required will depend upon the operating voltages of the indicator and the amount of bias required. The only real objection to this scheme is that the cathode current of some indicators varies from tube to tube, making the value of resistor difficult to predict.

If you are wondering why it is not easier to return the cathode of the indicator to the cathode of the duo-diode pentode or triode valve a few moments thought will show that if the pentode or triode valve is an audio voltage amplifier the additional cathode current of the indicator through the common cathode resistor will over-bias the valve.

If the value of the cathode resistor is then reduced so that the static voltage developed is correct for the valve, variations in cathode current of individual indicator tubes may alter the operating point of the valve. This is not desirable.

SHADOW ANGLE

In general use the amount of variation obtained in the indicator "shadow" will depend somewhat upon the overall gain of the set, the number of stages controlled by the AVC voltage and the amount of "delay" bias applied in a "delayed AVC" system.

That just about covers the general operating conditions required by the grid/cathode circuit of the indicator. Little else remains to be dealt with apart from the operating potential for the target anode.

Although the rated operating voltage for the target anode is 250 volts you will notice that in some circuit diagrams a voltage dropping resistor is inserted between the high tension and the target anode. This is generally recommended where the high tension voltage is higher than about 200 volts. While the brilliance of the fluorescent screen will be decreased slightly the useful life of the screen will be increased.

SERIES RESISTOR

The choice of 0.02 megohm for this dropping resistor is about an optimum value. Even with a value of 0.05 or slightly higher, the brilliance is quite adequate. Where the high tension is much over the 250 mark the value of this resistor could well go up to 0.05 megohm.

The indicator is mounted so that it can be viewed through a cut-out in the cabinet. Decorative bakelite escutcheons are available to "dress" such cut-outs. Some dials provide an appropriate hole in the back-plate aligning with an escutcheon printed on the dial glass. Connections to the "eye" are made through a covered standard socket which plugs on to the base pins.

The use of a tuning indicator is not limited to aiding the tuning of broadcast receivers. In addition to doing that job in a shortwave receiver it can also "stand-in" as a signal strength indicator. Suitably mounted on the front panel of such a set with a graduated scale attached to the panel underneath the "shadow" it can be quite handy in that respect.

Other uses include null-point indicator for an impedance bridge test unit and, with suitable calibration, a rough high impedance voltmeter.

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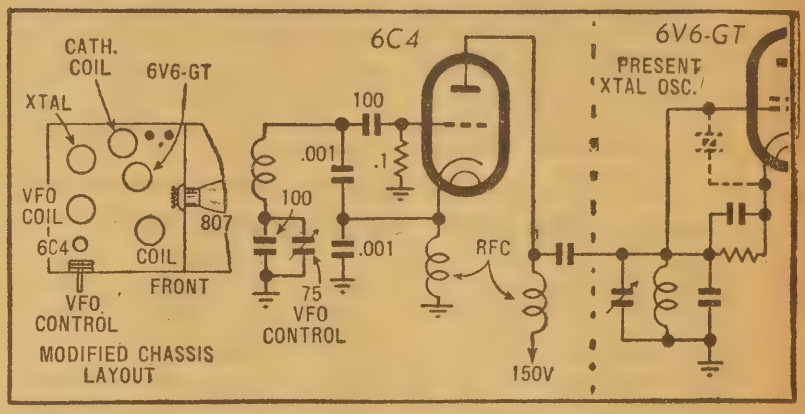
A READER BUILT IT!

Gadgets and circuits which we have not actually tried out, but published for the general interest of beginners and experimenters.

A VFO FOR THE R & H TWO-STAGE TRANSMITTER

The facility of variable-frequency control is handy in any amateur transmitter. Here is how a NSW reader went about adding this feature to the Simple 2-Stage Transmitter described in the October, 1948 issue of Radio and Hobbies.



OUR contributor is a licenced amateur who uses this 2-stage transmitter on his portable jaunts. His idea was to fit variable-frequency control without going to too much trouble and without entering into undue modification of the existing set-up.

The series-tuned Colpitts or "Clapp" oscillator circuit was selected for reason of its stable frequency characteristic and used with the miniature 6C4-type valve. The existing chassis layout of the oscillator section of the transmitter was rearranged slightly in the manner illustrated in the diagram. The only structural change involved was the punching of an extra hole to take the displaced cathode coil of the crystal oscillator. The existing cathode coil socket was wired as the VFO grid circuit coil, the 807 final stage 3.5 mc coil being used for this position.

There is just enough space to take the extra socket provided that one of the key terminals is moved to the other side of its companion. It will probably be necessary to remove the metal surround of some socket types and hold it in place with the usual retaining clip.

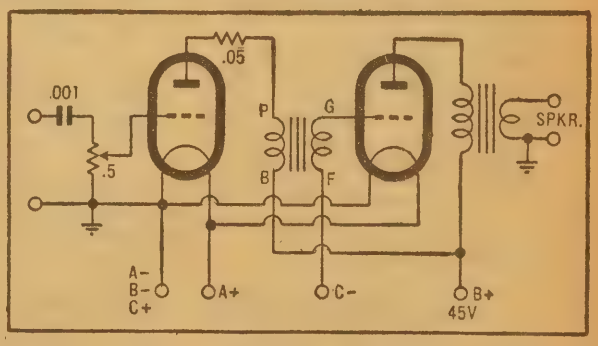
The mounting of the 75 pf capacitator will depend upon its physical size. It could go in the position of the 6V6-GT tuning by shifting this control to the centre and placing the meter switch above the chassis. But be prepared to place a shield plate between the 6V6-GT and final tuning capacitors if instability occurs in the final as a result of coupling between them. Keep their stator plates in opposite directions.

The drive is taken from the plate circuit of the 6C4 to the cathode circuit of the 6V6-GT. This produces about 4 mA of grid current to the 807 on 7 mc. Drive taken from the cathode of the 6C4 did not produce the same amount of grid current in the final. Our contributor did not mention whether he was selecting the second harmonic of the VFO or frequency-doubling in the 6V6-GT. Nor do we know the voltage which was being used on the transmitter proper.

The method of changing from crystal control to VFO control is best left to the individual. It will be necessary to control the HT to the 6C4 and to switch the crystal in and out of circuit when required. The connection between the 6C4 output and the 6V6-GT cathode circuit can be left intact provided that it does not seriously alter the tuning of the cathode circuit for crystal use. The simplest arrangement would be to place a single switch in the 6C4 HT and to physically remove the crystal when changing to VFO control.

TRACER FOR OUTSIDE SERVICE

Not all servicemen use a signal tracer to track down faults in a radio set. But for those who favor this method of approach, here are the details of a simple tracer submitted by a Victorian reader.



OUR contributor, Mr. R. Ridgeway, of Haddle Rd., Foster, Victoria, built the unit from the usual junk components found around any radio workshop. He claims satisfactory performance even to the extent of being comparable with that of a commercial unit.

The circuit could not be more simple. It consists of a 'grid-leak' detector transformer-coupled to a triode output stage. For audio frequencies, it acts as a two-stage amplifier. The .05 megohm resistor in series with the plate of the first triode is probably to limit the plate current in the valve used which was an old type A409.

The other valve was a B406. Any battery triodes or pentodes could be used. Where applicable, it would be necessary to select a level of C battery bias which would keep the plate current within its limits for the 45-volt plate condition. Alternatively, a back-bias arrangement could be used.

The selection of batteries other than the B supply will depend upon the valve types used. Mr. Ridgeway used a 4.5 volt C battery for the filaments and a 1.5 volt torch cell for the bias. The B battery can be a Minimax 45v. or 67.5v.

Our contributor did not say anything about the degree of loading imposed by the unit upon tuned circuits but he did mention that when using a shielded lead to feed the signal into the tracer, it was not necessary to use the earth connection although it did improve the performance a little.

PARTS LIST FOR "PLAYMASTERS"

In response to many requests from our readers we are printing herewith a complete set of parts for the Playmaster series of equipment. We had considered that the comparative simplicity of the circuits would have made parts lists easy to compile, but apparently many still like to have the job done for them.

ACTUALLY we don't mind doing it, in the least, and have taken the opportunity of working out suggested ratings for condensers and resistors. These should be quite worth while, particularly for the less experienced constructors who sometimes don't know which to choose from the array of parts which confront them when they set out to buy.

From our mailbag it is evident that the amplifiers have created a great deal of interest. Several readers have said that their Playmasters were their first constructional effort, but which nevertheless worked from the word "go." Others have been most enthusiastic about their results, which apparently justify our contention that they should equal those of more elaborate designs without the "bugs" which often go with them.

We do know that the sale of switches of the type used in the equipment has been high enough to dry up stocks in some cases, although this is likely to be a temporary shortage only. All this is most encouraging, and has repaid us in no small measure for the work we put into the development of the complete series.

Only two errors crept into our circuits, for which we make due apology. The first occurred in the Control Unit No. 1, in which the original circuit showed no grid resistor for the second section of the ECC33. The circuit was reprinted correctly in the November issue, showing a 1 meg resistor from this second grid to the earth. It was a rather obvious omission in any case, and one not likely to mislead the average builder, particularly as its value was the subject of some discussion in the article.

"PLAYMASTER" AMPLIFIER, No. 1

1 Chassis 12" x 10" x 3".

1 Power transformer 425 Volts per side, 175 mA, 6.3V C.T. 2A, 6.3V 2A, 5V 3A.

1 150 mA filter choke.

1 Output transformer 10,000 ohm P-P to 15 ohm (or to speaker voice coil impedance).

2 Octal sockets, 1 6-pin socket, 2 5-pin sockets.

1 4-pin socket and plug for speaker and 1 7-pin miniature socket. 1 6-pin plug.

VALVES

1 6AU6, 1 6J5 (or any standard triode), 2 807's, 1 5U4-G.

CAPACITORS

1 100pf, 3 .05 mfd 600VW, 1 .5 mfd 400VW, 6 16 mfd 600PV electros., 2 25 mfd 40PV electros.

RESISTORS

3 100 ohm, 1 250 ohm 5W, 3 1000 ohm, 1 3000 ohm, 1 5000 ohm, 1 5000 ohm 10W, 1 .01 meg 10W, 3 .05 meg, 1 .1 meg, 2 .2 meg, 5 .25 meg, 1 1 meg, 1 2 meg.

SUNDRIES

6" of resistor mounting strip, 1 5-tag mounting strip, grommets, power flex and plug, hook-up wire, nuts, bolts, solder, lugs, &c.

"PLAYMASTER" AMPLIFIER, No. 2

1 Chassis 12" x 10" x 3".

1 Power transformer 285V per side, 125 mA, 6.3V C.T. 3A, 6.3V 2A, 5V 2A.

1 125 mA filter choke.

1 Output transformer 10,000 P-P to 15 ohms (or to speaker voice coil impedance) OP63 or similar.

4 Octal sockets, 1 6-pin socket, 1 4-pin socket and plug for speaker and 1 7-pin miniature socket, 1 6-pin plug.

VALVES

1 6AU6, 1 6SJ7 (or a standard triode), 2 6V6-GT's, 1 5V4-G.

CAPACITORS

1 100 pf, 3 .05 mfd 200VW, 1 .5 mfd 400VW, 1 8 mfd 525PV electrolytic, 3 16 mfd 525PV electros., 2 25 mfd 40PV electros.

RESISTORS

1 100 ohm, 1 250 ohm 3W, 1 1000 ohm, 1 2000 ohm, 1 3000 ohm, 1 5000 ohm, 1 .025 meg, 2 .05 meg, 1 .2 meg, 3 .5 meg, 1 1 meg, 1 2 meg.

SUNDRIES

6" of resistor mounting strip, 2 8-tag mounting strips, grommets, power flex and plug, hook-up wire, nuts, bolts, solder, lugs, &c.

"PLAYMASTER" JUNIOR, No. 3

1 Chassis 9½ x 6 x 2½.

1 Power Transformer 285V at 80ma, 5V, 6.3V.

1 Filter Choke 60 or 80ma, 30H.

1 Output Transformer — Primary 5000 ohms, wide range type to suit speaker.

2 Octal sockets.

1 7-pin miniature.

1 6-pin socket.

VALVES:

6V6-GT, 6AU6, 5V4G.

CONDENSERS:

1 .05, 1 .25, 2 25 electrolytics, 1 8mfd electrolytic.

3 16mfd electrolytics.

RESISTORS, 1 watt—2 1meg, 1 .5 meg, 1 .25 meg, 1 .1 meg, 1 10,000 ohm, 1 100 ohm feedback resistor.

RESISTORS wire wound—1 2000 ohm 5 watt, 1 250 ohm 3 watt, 1 50 ohm filament CT.

SUNDRIES:

Speaker plug and socket, hookup wire, power flex, insulated mounting strips, solder lugs, nuts, bolts, etc.

CONTROL UNIT 2

The second slip was in the circuit of the Control Unit No. 2. In switch section S3, at the extreme top right-hand side of the circuit, positions 2 and 3 were shown joined together. This placed a top-cut condenser in the "straight" position of the switch, which we did not intend. The correction lies in deleting the connection between these two positions so that the condenser operates only in position 2. The operation of the unit would not otherwise be affected.

One or two have asked whether engraved panels will be available for the control units. We have not specified such panels, mainly for the reason that, should a constructor desire to go to such trouble, it is far more likely that he will arrange for the engraving to suit himself, and made on a panel with some special finish to match his own ideas. Therefore the metalwork you buy will probably be plain, but capable of being engraved should you so desire.

VOICE COIL FILTERS

An interesting point arises when using one of our progressive top-cut, voice-coil filters with these amplifiers and, for that matter, with any amplifier using voice-coil feedback. There is apparently a tendency in a few cases for the amplifier to be shocked into high frequency oscillation with the filter in the 11½ Kc position, due, no doubt, to the insertion into the feedback network of the rather complex, reactive load represented by the filter. No such trouble was present on the lower cut positions.

Now that microgroove records are with us to provide range, it isn't so important to chase high frequency results from 78's. This raises the question whether it would be best to use merely a single cut for 78's, say at 6.5 or 8.5 Kc, cutting the filter out

altogether for microgroove. It also means that this tendency to oscillate isn't important if we give up the unequal struggle and limit our response with all 78's, just like the ABC do!

We'd like to hear from readers who have used the filter with the Playmasters, whether they have struck trouble or not. If it comes to that, the filter is built mainly of items from disposals or the junk-box, so that nothing much is involved if it should be discarded altogether.

A HANDBOOK ?

We are giving some serious thought to producing an Amplifier Handbook in the near future which, apart from containing grouped information on the Playmasters and their use, will include circuits of many other types of amplifiers, together with articles on speakers, enclosures, pick-ups, records, and subjects of a general nature.

We may also be able to collect some useful reference date on design and materials for the help of amplifier builders. This new material, added to that already published but now out of print, should result in a most valuable manual on a subject which has an amazingly wide following in Australia. In fact, amplifier articles might well be classed as the most popular of them all.

Let us know if you like the idea, and whether you consider such a handbook would interest you. Personally, we think it might easily become a best-seller. What do you think?

"PLAYMASTER" TUNER, No. 1 (Superhet)

1 chassis 12½in by 5½in by 2¾in.
1 4/5 D/W coil unit or 2 broadcast coils, aerial and osc. (suit 6AN7 valve or similar).
1 2-section gang tuning capacitor.
1 dial with glass to suit (USL32 or similar).
2 455 kc IF transformers (Nos 1 and 2).
1 2-pole, 2-position wafer switch.
2 gang trimming capacitors (for broadcast version).
2 9-pin miniature sockets, 1 5-pin plug with cover.
1 6AN7, 1 6N8.

VALVES

RESISTORS

1 2meg., 1 1 meg., 2 .25 meg., 2 .1 meg., 2 .05 meg., 1 .025 meg 2 watt (or 2 .05 meg. 1 watt in parallel, 1 .02 meg., 1 300 ohm, 1 200 ohm.

CAPACITORS

1 25 mfd 40PV electro, 1 8 mfd 525PV elecro, 3 .1 mfd 400VW, 2 .1 mfd 200 VW, 1 .05 mfd 400VW, 3 .05 mfd 200VW, 1 400pf mica low tolerance (for broadcast version), 3 100pf mica, 1 50pf mica.

SUNDRIES

3 knobs, 2 terminals (1 red, 1 black). 1 shaft coupling, a few inches of ¼in extension shaft, 1 5-tag and 12-tag mounting strip, scrap aluminimum for coil unit mounting, 2 to 3 feet shielded hook-up wire, 1 rubber grommet, solder, solder lugs, hook-up wire. nuts, bolts, etc.

"PLAYMASTER" BABY, No. 4

1 Chassis 9½" x 6" x 2½".
1 Power transformer 285 volts per side, 60 mA, 6.3V 2A, 5V 2A.
1 60 mA filter choke.
1 Output transformer 5000 ohm load to 15 ohm (or speaker voice coil impedance), OP24 or similar.
3 Octal sockets, 1 7-pin miniature socket and 1 4-pin socket and plug for speaker.
1 3-pole 3-position single gang rotary switch.

VALVES

1 ECC35, 1 6M5, 1 5Y3-GT.

CAPACITORS

1 .001 mfd, 1 .002 mfd, 1 .02 mfd, 1 .04 mfd (2 x .02 mfd), 2 .05 mfd, 400VW, 3 16 mfd 525PV electros., 3 25 mfd 40PV electros.

RESISTORS

1 100 ohm, 1 175 ohm, 3 2500 ohm, 1 5000 ohm, 1 .025 meg, 1 .05 meg, 1 .1 meg, 3 .25 meg, 1 .5 meg, 1 1 meg potentiometer

SUNDRIES

2 8-tag mounting strips, 1 3-tag mounting strip, 2 knobs, power flex and plug, shielded hook-up wire, hook-up wire, nuts, bolts, solder, lugs, &c.

"PLAYMASTER" CONTROL HEAD, No. 1

1 Panel 7" x 3½".
1 Case 6" x 3¼" x 3¼".
1 Octal socket, 1 6-pin socket, 1 5-pin socket,
1 6-pin plug, 1 5-pin plug.
1 3-pole 4-position single gang rotary switch.

VALVE

1 ECC33.

CAPACITORS

1 .002 mfd, 1 .005 mfd, 1 .008 mfd, 1 .02 mfd, 1 .04 mfd (2 x .02 mfd), 1 .05 mfd 400VW, 1 .1 mfd 400VW, 1 8 mfd 600PV electrolytic, 1 25 mfd 40PV electro.

RESISTORS

1 500 ohm, 1 1000 ohm, 1 5000 ohm, 1 .015 meg, 1 .025 meg, 2 .05 meg, 1 1 meg, 1 2 meg, 1 .25 meg potentiometer.

SUNDRIES

Aluminium for valve bracket, 2 8-tag mounting strips, 2 knobs, shielded hook-up wire, hook-up wire, nuts, bolts, solder, lugs, &c.

"PLAYMASTER" CONTROL HEAD, No. 2

1 Panel 11½" x 3½".
1 Case 10" x 3½" x 3¼".
1 Octal socket, 1 6-pin socket, 1 5-pin socket.
1 6-pin plug, 1 5-pin plug.
1 2-pole 5-position two-gang rotary switch.
2 2-pole 5-position single gang rotary switches.

VALVE

1 ECC33.

CAPACITORS

1 25 pf mica, 1 50 pf mica, 1 .002 mfd, 1 .003 mfd, 1 .004 mfd, 1 .006 mfd, 1 .008 mfd, 2 .01 mfd, 2 .02 mfd, 1 .04 mfd (2 x .02 mfd), 2 .05 mfd 400VW, 1 8 mfd 600PV electrolytic, 2 25 mfd 40PV electro.

RESISTORS

2 1000 ohm, 1 .015 meg, 1 .02 meg, 1 .025 meg, 3 .05 meg, 3 .2 meg, 1 5 meg, 1 1 meg potentiometer.

SUNDRIES

Aluminium for valve bracket, 2 8-tag mounting strips, 4 knobs, shielded hook-up wire, hook-up wire, nuts, bolts, solder, &c.

"PLAYMASTER" TUNER, No. 2 (TRF)

1 Chassis (10" x 6½" x 2¾").
1 Dial to suit gang (USL/32 or similar).
1 Aerial Coil.
2 RF Coils.
1 100mH coil (see diagram).
3 Octal sockets, 1 5-pin plug.

VALVES:

1 6SK7-GT, 1 6AR7-GT, 1 6SJ7-GT.

CAPACITORS:

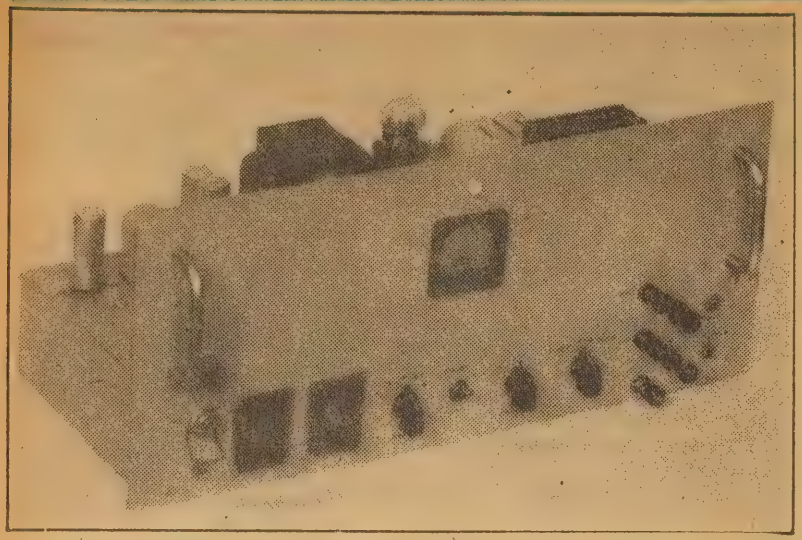
1 3 section gang (AWA or "H" type)
3 Trimmer capacitors.
3 100 pf mica.
2 .005 mfd. mica.
1 .02 mfd. 200VW.
2 .05 mfd. 200VW.
3 .1 mfd. 200VW.
3 .1 mfd. 400VW.
1 8mfd. 525V electrolytic.
1 25 mfd. 40V electrolytic.

RESISTORS:

2 300 ohm ½W.
1 2000 ohm 1W.
1 .025 meg. ½W.
1 .04 meg. 1W.
2 .05 meg. ½W.
1 .05 meg. 1W.
1 .07 meg. ½W.
2 .1 meg. 1W.
1 .1 meg. potentionmeter.
1 .25 meg. ½W.
2 1 meg. ½W.
1 2 meg. ½W.

SUNDRIES:

Knob, terminals, tag strips, hook-up wire, shielded hook-up wire, solder lugs, nuts and bolts.



The amplifier has an 18-inch panel. Conrols are, from left, Mic. volume, PU volume, bass, standby switch, treble and function switch. Input jacks are at the left, output terminals and jacks at the right.

A HOME RECORDING AMPLIFIER

This is not intended as a constructional feature but is rather, the story of a recording amplifier which literally "grew up" from humble beginnings. If the article provides ideas and food for thought for recording enthusiasts, it will have served its immediate purpose.

by W. N. Williams

IN its original form the amplifier dated back to around 1946-47, when the writer was specially interested in home recording.

Even at that time the usual approach to the subject was to obtain the best available motor, rig up some kind of traversing mechanism and re-vamp a pickup to serve as a cutting head.

Under these conditions it was difficult to assume any figures at all for impedance, driving power and ultimate frequency response.

As a result our recording amplifier, which was later described in the September, 1947, issue, used an 807 and a special output transformer to get as much power as possible and a choice of impedance values from a single-ended amplifier.

COMPENSATION

A compensating stage provided bass cut and treble-boost facilities, on the safe assumption that these would be required, while there was also provision for mixing and a microphone input.

The amplifier did a reasonable job until the need for it waned, after which it was relegated to general "hack" work around the shack.

More recently the subject of home recording has again come to the forefront, but this time on a much firmer basis. The use of microgroove has greatly reduced disc "upkeep," while most enthusiasts are at present using "Byer" equipment, or something very similar.

It has been possible to assume a power requirement not exceeding about two watts, a nominal impedance of 4000 ohms and a frequency response which can be controlled fairly closely by the amplifier design.

Out of this came the R and H Junior Recorder described by John Moyle in the April, 1951, issue.

Readers will remember that it featured a rather novel method of feed to the cutting head, making use of the naturally high plate impedance of an uncompensated tetrode. This allowed the voltage across the head to rise with the head's own impedance, tending to keep the ampere-turns and therefore the stylus drive more nearly constant.

Some really excellent records have been made since on this equipment, the quality generally being better overall than from standard 78 rpm pressings.

From the writer's point of view the Junior Recorder did not provide the necessary facilities for simple dramatic recordings, film commentaries and such like, which require continuous and smooth mixing of voice, music and possibly sound effects.

Faced with these requirements, we simply took out the old recording amplifier and began to change things around. That was the starting point.

Looking at the circuit you will see that the 807 output valve has been retained, under operating conditions which deliver something like 11 watts to the transformer primary.

In other respects the circuit follows that of the Junior Recorder, with a negative feedback system to the previous valve controlled by the 3 x 3 function switch S2, and in particular by section S2a.

In position 1 the feedback is operative at all frequencies and the amplifier has characteristics suitable for feeding a loudspeaker.

In positions 2 and 3 the feedback is partially removed, providing the high source impedance already mentioned to feed the head.

Switch section S2b brings the cutter in or out of circuit, while S2c controls the speaker voice coil circuit. In position 1 the full output goes to the voice coil for playback purposes. In position 2 only portion of the output is fed to the speaker for low-level monitoring while actually cutting. Position 3 cuts the speaker out of circuit altogether.

You will notice a 40 mfd electrolytic across the voice coil circuit which does not appear in the Junior Recorder. Purpose of this is to prevent accentuation of the treble when the speaker is serving as a monitor on Record. An electrolytic is actually out of role in this position but it does help to maintain a better tonal balance and this is sometimes important.

Some form of monitoring is, of course, essential wherever mixing is attempted, but speaker monitoring is satisfactory only where a separate control room is available. In the home, monitoring will generally need to be done with phones.

In line with this requirement the output from the 2-ohm voice coil winding is made available through a jack, so that phones can be used at any time simply plugging them in.

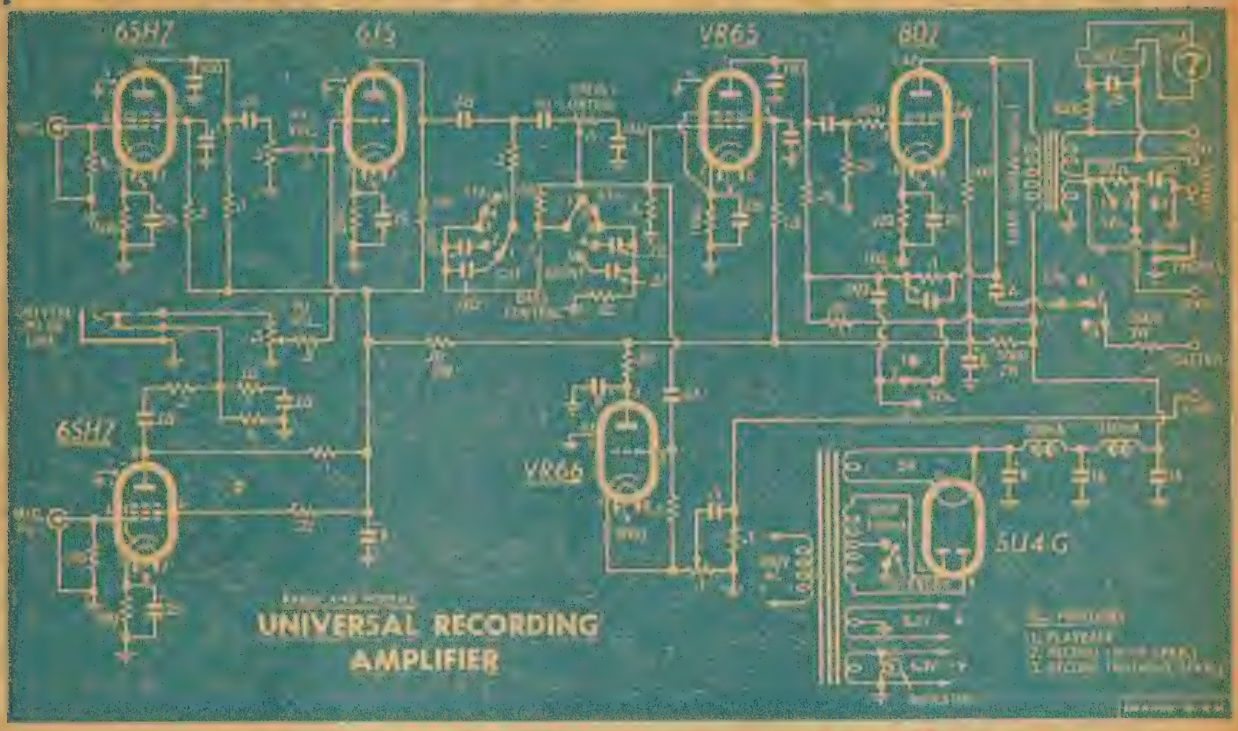
NOTHING NEW

All this is straightforward and represents only a slight elaboration on the "Junior Recorder" circuit.

It so happened, however, that the original output transformer—an early Ferguson prototype—had a 500-ohm secondary as well as the voice coil winding and intended for possible use with a 500-ohm cutter.

It can still be used for this purpose, but its main function in the present amplifier is to feed a telephone type rectifier and a 5-milliamp meter, serving as an output indicator. This it does very nicely, without unduly loading the circuit.

CIRCUIT GIVES MIXING AND RECORDING FACILITIES



The complete circuit looks rather involved but breaks up easily enough into distinct sections. The cathode follower feeding a separate output line was added when the need arose to use the amplifier as a mixing panel to feed a tape recorder. By such steps the circuit "grew."

The meter, incidentally, was an ex-disposals "Ferranti" type, selected because it exhibited a very fast action and ability to register peaks. Many highly-damped meters are completely useless for this service.

Note that a .25 mfd. condenser is shown connected across the rectifier. Purpose of this is to prevent the meter from registering the high peak voltages developed by high notes across the rising cutter impedance. There is seldom any danger of overcutting at such frequencies and, with a suitable bypass across the metering circuit, a better relationship can be established between the signal voltage and the cutter amplitude.

A 5-milliamp meter cannot well be operated directly from the plate circuit and, had no 500-ohm winding been available, it would have been necessary to use a 1-milliamp meter and a suitable rectifier, as in the "Junior Recorder." A lower value of bypass would also be required.

Moving forward from the output valve, the main voltage amplifier is a VR65, the same high-gain pentode as used in the original amplifier. A valve of the 6SH7 or 6AU6 class could be substituted, preferably with a reduction in screen resistor, and with some loss in gain.

TREBLE BOOST

The main point of note in this stage is the use of a deliberately low value of cathode bypass to provide a small measure of treble boost. Purpose of this is to offset the inevitable loss which occurs in the top response in the mixer and amplifier stages.

The figure of .05 mfd. was arrived at by trial and error, and, with this condenser in position, the response from microphone jack to output plate is almost exactly level—this with the "Function Switch" in the "Record" position and the gain control half on.

Ahead of the VR65 is a 6J5 triode feeding a tone compensating network. Almost any general-purpose triode of triode-connected pentode would serve equally well in this position.

The bass control circuit uses a 2-pole 5-position switch giving "Level" response and two degrees each of bass cut and bass boost. The operation of this circuit is exactly as used in the R. and H. "Universal Tone Control" and the "Playmaster Control Head No. 2."

CONTROL DIFFERENT

The treble control is different, however, in that it takes the form of a potentiometer which gives a gradual change from treble cut to treble boost, with "level" somewhere near the centre setting. There is a definite reason for this choice.

One use of such a control is to apply treble boost when recording near the centre of a disc, thus achieving what is commonly referred to as "Radius Correction." If used in this way, the control has to be varied slowly throughout the recording of a side and a smooth, noiseless variation is essential.

The control, as shown, is completely silent in operation and can also be used, amongst other things, to diminish noise from a worn record, take the "edge" off a rough voice, and so on.

There is, indeed, something to be said for making the bass control likewise continuously variable. It can be done with two condensers and a potentiometer, but, unless extreme care is taken in the selection of the correcting condensers, a somewhat "lumpy" response may be obtained in the nominally "level" position.

POT. CONTROL

Sufficient to say that we started off with a switch and the urge to change over to "pot" control has not been sufficiently urgent to see out its installation.

The mixer circuit, involving two potentiometers and two resistors, connects in the grid circuit of the tone control valve.

It is obvious that the whole circuit from the "grid" side of the isolating resistors onwards is "alive" and capable of picking up hum, quite irrespective of the gain controls. Extreme care is therefore necessary with wiring, layout and shielding.

In the original amplifier, the pots. were earthed back to a point near the 6J5 socket. In fact, we wound the earthing wire around the half-watt isolating resistors so that they were shielded by it.

The lead from the resistor junction to the grid was shielded, likewise any lead of significant length carrying signal into the control network or out of it into the VR65 grid.

Components which could not be shielded were mounted close against the chassis and the heater wires thoroughly twisted and kept out of the way.

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EXCELAIR RADIO

136 Victoria Road, Marrickville, N.S.W.

The amplifier from the rear. The Mic. and PU amplifiers are at the right, the stages progressing to the 807 at the left. Power equipment and filtering runs along the back, the transformer being furthest from the input circuits.

The heater circuit needed special treatment, as in any high-gain amplifier. We tried earthing by the centre tap and by either side, and with various tubes in the sockets, until the lowest hum level was achieved.

For the mic. amplifier, we used a metal 6SH7, which, by and large, appears to be a better proposition than the glass versions of the same type. The miniature 6AU6, with identical electrical characteristics, would have been the logical ohoice but for the fact that the 6SH7's were available from "the box."

Gain on the "Mic." channel is adequate for one of the better quality crystal microphones.

For high-level inputs, we initially installed a phone jack, into which a crystal pickup could be plugged.

CRYSTAL PEAK

It transpired, however, that the characteristic mid-frequency peak made this type of pickup unsuitable with noisy sound-effects records in particular, and a compensating preamplifier was installed to allow a magnetic pickup to be used.

Output from this stage is wired, as shown, through the jack. So the front end "grew up."

The final addition was made desirable when the need arose to feed a tape-recorder simultaneously with the cutting head.

Attempts to pick up output from the last two stages were foiled by their artificial frequency response — plus hum and level problems. There were obvious objections also to attaching a long, shielded lead to the early high-impedance circuits.

To cut a long story short, a cathode follower was added, taking its output in parallel with the grid of the VR65. This delivers approximate zero level to the "line" output jack, although it can be cut back to mic. level with the control potentiometer.

The feed for the cathode follower cannot well be taken from anywhere inside the feedback loop, since the waveform in this portion of the circuit is a variable mixture of the orginal signal plus the feedback and its out-of-phase distortion content.

As it is, the "line" output is completely independent of the function switch setting and the amplifier can be used, quite well, as a preamp., compensating and mixer panel to feed other equipment.

The two photographs show the general layout of the chassis and panel. Both are systematic enough, although dictated in detail by the wartime metal work on which the original amplifier was built.

After using the amplifier quite a deal in this form, our reaction is that it is quite handy and practical as a single unit. The facilities are adequate for simple dramatic and dubbing work.

For ambitious work, however, facilities for two turntables with faders and a higher quality (and possibly lower level) microphone would be essential. Better placing of the controls would be warranted and, at this stage, I personally would prefer to go the whole distance and provide a complete mixing panel with separate power supply and output stages.

In the meantime, however, my electronic "Topsy," which has "just growed," has proved very useful.

Mantel Set

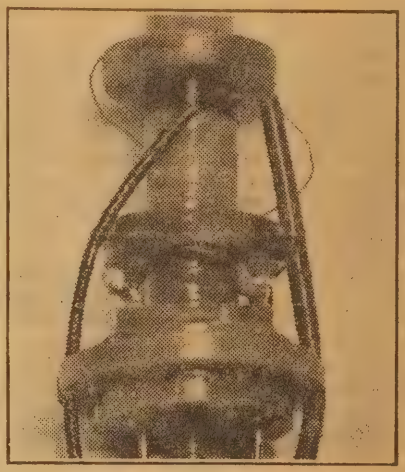
(Continued from Page 33)

the aerial input. Connect these lugs together with a run of light gauge tinned copper wire.

With regard to the modified IF transformer, one point is worth mentioning. Keep that side of the feedback winding which connects to the detector plate away from the wiring of the 6AN7 socket, otherwise some undesirable coupling may produce a feedback condition which could be controllable by the setting of the volume control—a condition which you don't want.

It can be avoided simply by taking the particular lead out of the transformer can at the base on the side closer to the ECC33 socket. In general, it is wise to keep any "hot" grid or plate leads as short as possible and tucked close to the chassis.

Incidentally, a local manufacturer may be turning out these special IF transformers for use in this set. At the moment we are unable to say anything definite on this matter.



Here is the modified IF transformer. Note the hand-wound feedback winding on the underside of the grid winding at the top. The spaghetti sleeving cemented at a couple of spots, feeds the leads out through the two grooves in the base.

Note that the 425 pf mica capacitor is a low tolerance type (5 pc or less). Because it sets the tracking between the aerial and oscillator tuned circuits, it is termed the "padding" or "padder" capacitor.

The wattage rating of the resistor is given in the parts list, the ½-watt size being suggested where possible to make for easier wiring. If desirable, the .025 megohm 2-watt can be made up by connecting two .05 megohm 1 watt resistors in parallel.

A final remark about the wiring is to avoid obstructing a line of approach to the aerial and oscillator coil slugs if you happen to be using those which have the slug protruding from the bottom. For the case where the slug protrudes from the top of the can, there are two corresponding holes in the side of the chassis to allow access to the slugs.

The first step in the circuit alignment is to see that the dial pointer has equal overlap at the extremities

(Continued on Page 107)

TRADE REVIEWS AND RELEASES

NEW GRADE TAPE FROM EMI

A new grade of the well known Emitape hes recently been released by EMI and features a high coercivity coating designed to provide much improved frequency response at moderate tape speeds.

THE makers claim that this tape has as high a coercivity as any other tapes at present available and list the following upper limits of frequency response (for 2 db drop) when used at the popular standard tape speeds. At 3¾in/second, 4000 cps.; at 7½in/second, 8000 cps., and at 15in/second, 15,000 cps. These figures would naturally assume optimum design of both record and playback heads.

Checked in our own laboratories on a medium-grade recorder, this tape, nevertheless, gave an excellent performance and it would appear that the claims to the above figures can be justified on adequate equipment.

As well as the frequency response, such equally important characteristics as tensile strength, print-through level, and instantaneous variation of sensitivity over the length of the spool, all appear to have very attractive figures, making the overall performance of the tape equal to the most stringent requirements of the professional recordist.

The tape is available on standard spools, with footage markings, in either 600 or 1200ft lengths, while special spools are available with EMI hubs and carrying 3250ft.

Not the least attractive feature of the new tape is the price, which remains the same as for the old LC coating, namely, £1/14/6 for 600ft, and £2/18/- for 1200ft. These prices compare more than favorably with those of other tapes at present on the market.

Stocks of this tape, in the various size spools, are currently available from EMI Sales and Service, 2 Parramatta Rd., Homebush, or through their distributors.

BOOK REVIEW

PHILIPS RADIO AND TELEVISION MANUAL, by E. G. Beard. 770 pages, hard cover, price 59/6.

Readers familiar with the original Philips Manual of Radio Practice will be interested to learn of the publication of a second, much enlarged version, known as Philips Radio and Television Manual.

Compiled by Mr. E. G. Beard this second edition consists of some 770 odd pages which cover just about every aspect of modern radio practice, as well as giving a hint of things to come in the form of UHF techniques generally and, of course, with particular emphasis on FM and television.

Although mathematics have not been shunned where absolutely necessary, they have been avoided where it is possible to adopt a less academic approach. The result is that the general presentation is in an easy style which should appeal to the young student equally with the serviceman or engineer.

The early chapters are devoted to the basic principles of transmission and reception while later sections explain how these general principles are applied in modern practice. The text is assisted by the use of numerous photographs, drawings and graphs and practically every section of a modern receiver is explained in detail.

Later chapters cover the more advanced modern practices and deal with everything from acoustics to UHF transmission lines and aerials. Grouped under one heading are useful mathematical formulas and tables, including a particularly comprehensive log table, together with a short explanation of their use.

Some 200 pages are devoted to useful valve data, curves, &c., of current types, while the television appendix covers over 60 pages.

As well as to the serviceman or engineer, this book should appeal particularly to the student who has just completed a course of study and is seeking to gather most of the basic principles which he has learnt into one volume and to co-relate them with current practice.

★ ★ ★

QUESTIONS AND ANSWERS ON RADIO AND TELEVISION, by E. Malloy. 144 pages, hard cover, published by Messrs Geo. Newnes and C. Arthur Pearson Ltd., London. Australian price 7/9 (approx.).

This handy little book presents the basic principles of radio in a rather novel way, namely, the question and answer technique. From the first question (and its answer) "What is an electric current?" to the final ones dealing with television separators, &c., it covers the important aspects of electricity and radio in a particularly clear and easy-to-understand manner.

The book is divided into appropriate sections to enable the reader to find the reference he requires with a minimum of searching.

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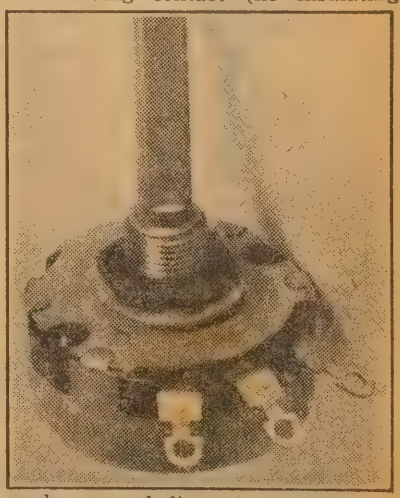

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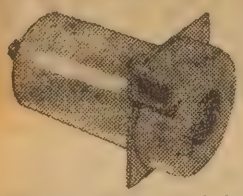

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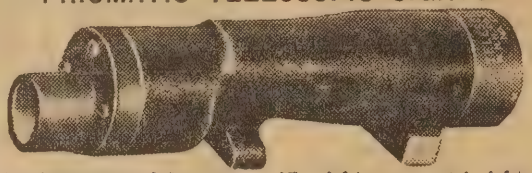

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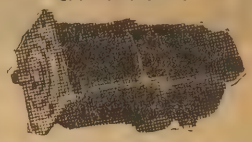

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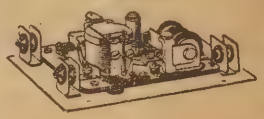

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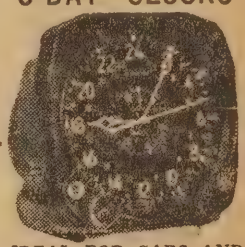

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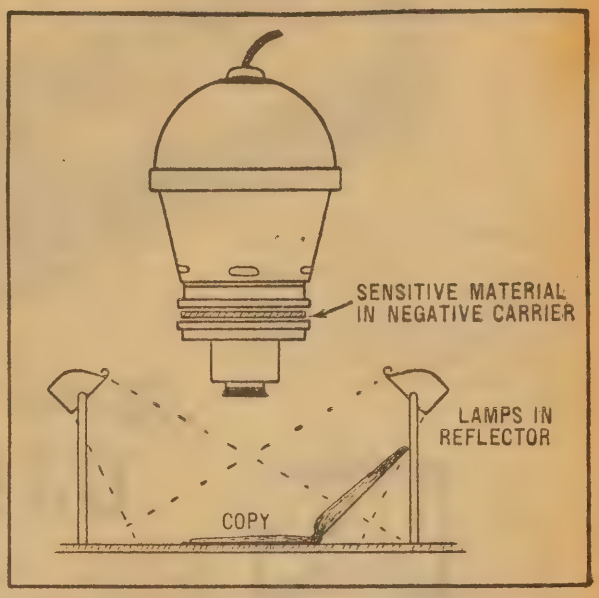
YOUR ENLARGER AS A CAMERA

A phase of photography which appeals to many advanced amateurs, but which is often neglected because of lack of equipment, is that of copying and close up work. In this article we discuss the use of the enlarger for this job and detail some of the work which can be done.



A typical set-up of lights on the enlarger base board to permit its use as a camera. Depending on the type of enlarger, it may be necessary to modify the negative carrier to avoid fogging the film. The lights need careful adjustment for even illumination.

THE use of the enlarger as a camera is not a new idea, but there are many workers who have hesitated to tackle this class of work because they believe that the enlarger must be specially designed for the job. Certainly, one which is so designed is to be preferred, but there is no reason at all why any good enlarger should not be used with a few simple modifications.

The uses to which such facilities can be put are almost unlimited and, once they are realised, the amateur worker will probably find this class of work one of the most interesting there is.

SOME SUGGESTIONS

Here are some of the possibilities: Copying diagrams and letterpress from articles which are normally available only on loan, particularly when such diagrams are so complex as to preclude their being copied by hand. In any case, the photographic copy is to be preferred in the interests of accuracy, a hand copy never being above suspicion in this regard.

Photographs for which there is no negative can be duplicated by this means, and, at the same time a new negative is produced. This calls for rather more skill than copying line drawings, and, for this reason, is a rather interesting phase of the work in itself. A variation of this is the salvaging of old photographs which have been damaged, the copying being mainly useful to mask the hand work necessary to "repair" the original.

Likewise, original line drawings may be copied in order to mask the hand work of an amateur draughtsman, while at the same time, the size may be altered (generally reduced) to suit the final requirements. This facility is particularly valuable for making labels and scales for home-made instruments and it is not hard to produce a really professional job.

USEFUL DISTORTION

There are two main reasons why such copying can improve the original, firstly, because it is possible to distort the contrast and secondly, because the original can be made much larger than the final requirement.

The first effect, distorted contrast, is achieved partly by the choice of sensitive material and partly by the processing technique, a combination of contrasty emulsion and prolonged development producing extreme contrast far in excess of that in the original. The result is that very few middle tones are recorded as such, all those lighter than a certain level being reproduced as pure white and all those darker than a certain level as full black. The range of tones between these two levels is extremely narrow.

Thus various shades of white and near-white will all be reproduced as the best white the paper will produce with no tone difference between them. Likewise, blacks and near-blacks will reproduce as blacks. This makes it possible to paste printed type on to a drawing without any fear of the "patches" showing in the final print, in spite of differences in tone and paper texture.

Similarly, errors may be corrected either by pasting over the part in question if it is a large area, or covering with process white for small ones. Graph paper, with blue lines, is most valuable for those whose artistic skill is limited, helping to keep everything shipshape, while it photographs as plain white paper, due to the excessive blue sensitivity of the film. Thus, an original, which appears as a horrible patch-work may be made to produce a copy which is virtually perfect.

by Philip Watson

The reduction in size is mainly useful in eliminating rough edges to lines, &c., and it is surprising how a reduction of even two diameters will "clean up" a drawing. If you can do even a reasonable job of hand lettering you will find that a reduction of three or four diameters will usually make your work quite acceptable.

For all work of this kind the enlarger is admirably suited, for it is (or should be) rigidly mounted, will have a high quality lens, and is designed for close working. The usual vertical mount is also convenient, making it unnecessary to use pins or other devices to hold the original copy.

Basic principle of the scheme is to place the sensitive material in the negative carrier, or a modified version of it, and then illuminate the original copy by means of auxiliary lamps on each side of the base board. The fact that there is normally no shutter on enlarger lenses is not a serious problem, the exposure being quite conveniently controlled by switching the lamps.

POINTS TO WATCH

The three main problems are: Some means of focusing and framing the subject, providing even illumination, and eliminating light leaks in the enlarger which would otherwise result in fogging of the film. Actually, the illumination and the light leaks are sometimes closely associated, and it is usually only when the enlarger is completely light-tight that one is free to arrange the illumination in the best possible way.

There are two ways of checking the focusing and framing. One is to substitute a piece of ground glass for the film and observe the image on it by removing the top of the lamp house.

This method is almost essential when photographing small solid objects, since it is necessary to check such details as lighting, reflections, depth of focus, &c., which are difficult, if not impossible, to check in any other way. The writer normally uses this method, even though it means "swiping" a kitchen stool to gain the necessary height.

The other method is place a focus-

ing negative in the position to be occupied by the film and project an image of it with the regular enlarger lamp. When this image is correctly focused and the area of projected light covers the subject, the latter may be regarded as correctly focused and framed. It is advisible to use a glass negative rather than a celluloid one as it is easier to ensure that it will occupy exactly the same plane as will the film.

This raises the question as to what form the negative holder should take. If the normal negative carrier uses two pieces of glass this can be used, but the glass presents two more surfaces to collect dust. A better idea is along the lines of the glassless carrier, where the negative is held between two metal plates with the correct size aperture punched in them.

HOLDING THE FILM

Where sensitive material is being held, the aperture in the rear plate is no longer necessary, and a plain plate, painted a matte black to minimise reflections, should be substituted. If the existing holder does not lend itself to these modifications it would be better to make one specially for this work and should not be beyond the skill of the average experimenter. Exact details, of course, will depend on the particular type of enlarger involved.

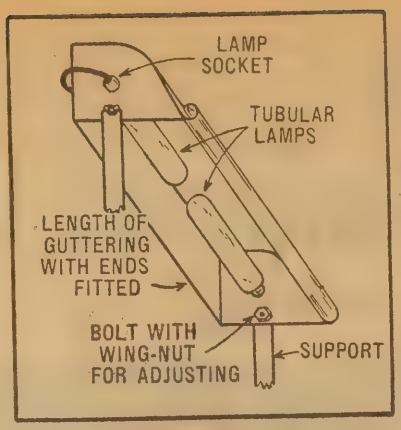
Even illumination is probably the biggest problem of the lot, particularly where large areas are involved, and if you are deluded into believing that the illumination is even because it looks even you are due for a shock. The mere fact that, in most cases, the contrast will be deliberately boosted only serves to aggravate any slight variations in light value.

The most even distribution of light occurs when the source is at a considerable distance from the subject, relative to the area of the latter. One rule is that the distance should be at least equal to the diagonal of the area, but this should be regarded as the bare minimum and greater distances are usually necessary. When this distance is increased beyond a certain point it will be found that some of the light is falling on the lamphouse and negative carrier, and minor light leaks may begin to be troublesome.

REFLECTORS

In any case, the lamps will need to be mounted in some kind of reflector, both to concentrate as much light as possible on to the subject and also to shade it as much as possible from the lamp house. Again the exact details will depend on what is already available, and can best be left to the individual to decide. However, the writer has seen excellent reflectors made from short lengths of ordinary guttering and used in conjunction with either standard globes or strip lights, the latter being tubular-shaped globes about 12in long and 1½in in diameter.

A guttering reflector, housing one or two such globes, and placed on each side of the baseboard will provide excellent illumination. The actual distance and placing will have to be finalised by experiment, so it it as well not to make the fitting permanent until some tests have been made. Light which strikes the copy from the side will tend to accentuate any irregularities in the surface, such as creases or bends, and it is better for it to be as near "straight on" as possible.



This underside view shows how two strip lights are mounted in a home-made reflector. The reflector itself is made from a length of guttering fitted with ends. Outside finish can be to taste but the inside should be painted flat white.

A good method of testing for even illumination is to photograph a sheet of plain white paper, using a piece of contrast bromide paper in place of film. Carefully adjust the exposure until it produces a mid grey with normal development, at least over the major portion of the exposed area, when it will be found that any irregularities in lighting will be clearly evident. The use of bromide paper is not only cheaper than using film, but it also gives a better indication due to the extremely short tone range tending to exaggerate any variations.

Remembering that the darker portions of the paper negative represent too much light on the subject, you can then proceed to modify the placing of the lights until best results are obtained. Once the best arrangement has been found it should be possible to make it a permanent one, which will not only ensure even lighting, but will also eliminate one more variable from the exposure calculations.

Sealing light leaks which may fog the film is not quite so difficult for this work as it is for normal enlarging, mainly because there is no longer any need to worry about heat in the lamp house. However, the device will still have to be used as an enlarger and any alterations may have to be of a temporary nature. Main point of trouble is around the film carrier, and if this can be made light tight within itself there may not be any need to modify the lamp house.

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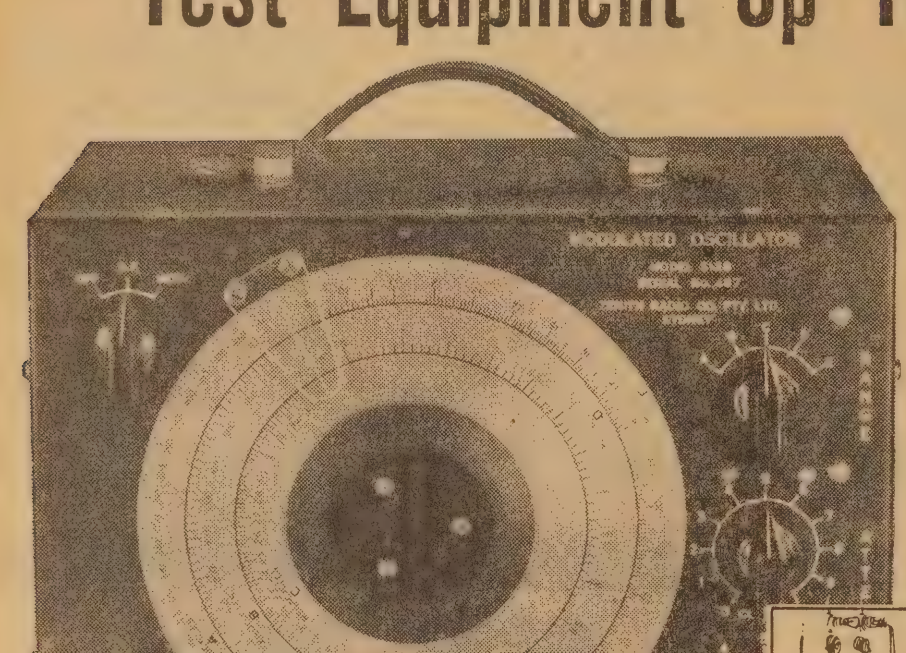

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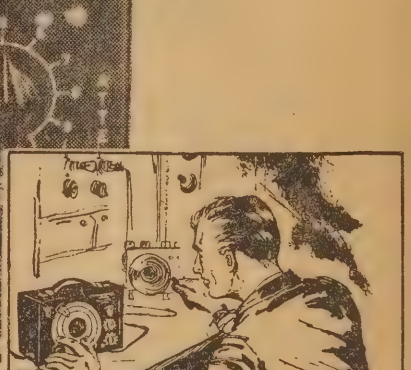

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The type of sensitive material suitable for this class of work will depend to some extent on the nature of the job to be done. Either plates or sheet films may be used, but the ability to cut off small pieces of film for testing is a point very much in their favor, particularly for the beginner, who will probably have to make a number of tests before he gets the results he wants.

For line drawings, letterpress, &c., a low sensitivity, high contrast emulsion is required and typical types are Kodak Contrast Process Ortho and Ilford Rapid Ortho Line.

Where a copy is simply required for record purposes, it is not essential that the original contrast be reproduced and, in fact, it is usually much easier to settle for a somewhat reduced contrast but which is, nevertheless, quite easy to read. In this way problems of even illumination are reduced, which is often of considerable importance where the copy cannot be made to lie perfectly flat, as, for example, the pages of a thick volume.

RESTRICTING CONTRAST

The use of normal or reduced development times will generally give such a result, particularly if the print is made on a medium contrast paper. Where maximum contrast is required, in order to mask handwork, &c., the development time may safely be increased up to twice the normal figure, providing the material is fresh, without fear of fog. When this is subsequently printed on a "hard" grade of paper, it will be found that a greater contrast than the original is obtained.

These films are sensitive mainly in the blue end of the spectrum which makes them quite suitable for ordinary black and white work and permits the use of a comfortable working safelight.

It also means that blue objects will be treated much the same as white ones, and there will be very little contrast between the two. This is usful when copying drawings from graph paper, since the blue lines are eliminated while the black ones remain. It should be noted here that the graph lines will probably be faintly visible in the negative, but the contrast will be too low to show on a print.

On the other hand, red objects will be treated as black, and a high contrast between red and white is obtained.

The blue sensitivity is a disadvantage, however, when blueprints or the like have to be copied and results are not usually satisfactory unless other means are adopted. Best method is the use of a panchromatic film, such as Kodak Process Pan or Ilford Panchro Line, in conjunction with a red filter. This will reproduce the blue as dark grey or black against which the white lines will show clearly.

COPYING PHOTOGRAPHS

For continuous tone work, ie, copying photographs or small solid objects, lower contrast films are desirable and something along the lines of Kodak Commercial Ortho or Ilford Commercial Ortho is about the best. Due to the natural characteristic of all emulsions it is almost impossible to produce a copy which contains all the original tones without distortion and at the same time having the original contrast.

If a lower contrast print is produced it will generally be found that most of the original tone differences will be retained, although there will be less contrast between them. When the original contrast is produced many of the tone differences at the extreme ends of both the highlight and shadow regions will be lost, becoming either a single white or black tone. This is where some skill and judgment will be necessary to select a satisfactory compromise and, perhaps, introduce some shading to help restore the original tones.

Exposure will have to be determined experimentally and in addition to such factors as distance from lamps, size of lamps, type of film, &c., the effective size of the lens stop, as distinct from the nominal size, must not be overlooked. The difference is due to the increased focal length required for close working and means that the lens has, effectively, a much smaller stop than when working at infinity or even at a distance of a few feet rather than the inches involved in close-up work.

For maximum contrast the exposure should be so adjusted that the blacks are reproduced as clear areas of negative while the white areas produce considerable density, and it is often worth while experimenting to get this value just right.

Many special developers have been evolved by the film manufacturers for the production of very high contrast negatives and these are, no doubt, admirably suited for those cases where the absolute maximum is required and long development times are a disadvantage. However, for the odd amateur job these are hardly justified and the writer has had excellent results using Kodak Dektol, which was chosen mainly because it was already on hand and normally used for bromide prints.

DEVELOPMENT

When used for films it is diluted one to one with water and normal development times for such films as Kodak Process, Contrast Process Ortho, or Commercial Ortho would be about three minutes at 68 degrees. For greater contrast, particularly with the first two types, this time can be doubled. Correct times for other temperatures can be obtained from the time-temperature graph for this developer.

It must be emphasised that these figures are only intended as a guide, and much will depend on the individual requirements. However, work of this kind gives plenty of scope for experiments, since results can be seen immediately and only a small piece of film need be used; not a whole roll, as with the regular camera.

One of the most valuable uses to which the writer has been able to put the line copying process is that of making labels for home-made instruments and scales for odd meters for which no suitable scale is available in the normal way. This latter facility is particularly attractive and a detailed description of the various steps may be of interest.

Usually a scale having the required range is available, but it is seldom that local scales will fit imported meters, such as have been available through disposals.

Even if such a scale is not available it is not beyond the skill of the ordinary person to produce the necessary art work, the main materials being ordinary drawing instruments, scissors and paste and some suitable-

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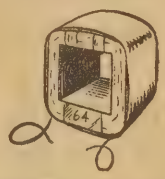

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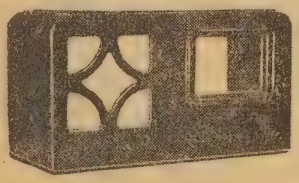

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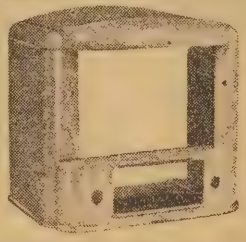

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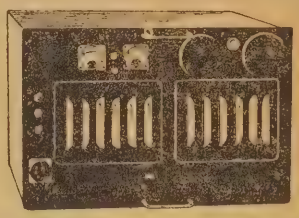
Easily worth 3/6. **Our price 1/6 each.**



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sized figures which can be cut up to form the necessary groups. A good source of such figures is a discarded sheet from a calendar or a cheap copy-book and it may sometimes be worth while copying these first to produce the required size.

However, it would be hardly advisable for a beginner to tackle the production of complex multi-range scale, since a considerable amount of work may be involved and the project only justified if a number of copies are required. When copying an existing scale remember that there may be legal objections to the commercial use of such copies, though there would appear to be no objection to their use privately.

THE NEGATIVE

In any case, whatever the type of copy, it is first necessary to make a negative of it. The size of the image on this negative, while not critical, should be such that the enlarger is able to project it to the required size. Since few enlargers are able to reduce the projected image and some even have a minimum enlargement about 1.5 diameter it is quite easy to make a negative which has too large an image.

When the negative is dry it is placed in the enlarger and the image projected to approximately the required size. It is now necessary to remove the original scale from the meter and place it on the base board where the projected image can be superimposed upon it. Now adjust the projected image until it exactly coincides with arc on the meter scale, a process which normally calls for a little juggling in order to maintain both correct size and focus.

Before removing the scale from the meter it is a good idea to observe just where the point of the needle falls with relation to the arc, as this information is sometimes helpful when it is necessary to substitute a multiple scale for a simple one.

When the projected image is considered to be as required, the scale is removed, the lamp turned off and a piece of contrast bromide paper placed in the paper holder. Then the orange filter is swung over the lens, the image projected again, and the scale placed on the paper so that the image coincides with it once again. The lamp is turned off and a weak white light of some kind turned on in order to fog that part of the paper which is not protected by the scale.

DELIBERATE FOGGING

The best way to do this is to mount a torch or dial lamp alongside the lens and operate it from a suitable battery.

The purpose of this fogging is to transfer the outline and mounting hole positions to the new scale and when this has been done the old scale is removed and the image projected for the correct time. Upon development this produces a scale which has the new ranges correctly placed with reference to the mounting holes and the outer edge. Since there is always the risk of damaging a scale when mounting it, it is a good idea to make two or three extra copies while the gear is set up, the cost of the paper being negligible.

The final step is to fix the new paper scale to the existing metal one and for this one of the cellulose cements, such as employed for model aircraft work, is used. To ensure that

(Continued on Page 112)

SHORT WAVE NOTES BY RAY SIMPSON

STATION DETAILS FROM BRAZIL

Quite an amount of information has recently been received concerning the many short-wave stations operating in this South American country and, as these Spanish-speaking stations have an attraction all their own, we will give as much information as possible to enable Australian listeners to tune them in.

ONE of the best-heard stations is Radio Jornal do Commercio, which has often been heard here over ZYK3 9.565 mc. This latter station is on the air in English from 6.25 am to 6.55 am, and also from 10 am to 10.30 am.

The actual schedule for this station is XYK2 15.145 mc from 7.55 pm to 5 am, ZYK2 6.085 mc 7 am to 12.20 pm, and over ZYK3 7.55 pm to 3 am and 5 am to 12.20 pm. Their program "Brazil Calling" is given on Monday at 6.30 am, the English announcer being Janet Slater Swaton.

This station is anxious to receive reports from listeners who hear their transmissions and these should be addressed to Propriedade da Emprea Jornal do Commercio AA, Recife, Pernambuco, Brazil. We are indebted to the Universlaite for most of the above details.

Radio Inconfidencia, PRK5, which normally operates on 6 mc has been reported heard on 15,185 mc from 5 am till 7.30 am, but, although we have heard a Portuguese speaking station on this channel, it did not appear to us to be PRK5. A New Zealand listener, Mr. Jack Corbett, has received a verification from ZYP23 Radio Quitandinha confirming his reception of their station on 5.045 mc. According to their letter they are on the air from 9 pm to 1 am and 7 am to 1 pm. Their address is Avenida Rio Branco 311-9, Andar, Rio de Janeiro, Brazil.

In the late afternoon we have heard ZYC8, which uses 9.61 mc and has the slogan Radio Tamoyo. This station has also been heard around 6 am, but is difficult to understand at that time.

Another Brazilian which has been heard of late is Radiodifusora Sao Paulo, which uses the call letters ZYB7 on their channel of 6.095 mc. The best time to hear this one is around 6 am.

JAPANESE OVERSEAS SERVICE

SOME months ago we published a paragraph advising that it was expected that the Japanese Broadcasting Corporation would shortly resume their overseas service and it would now appear that it is in operation. Before the war the Japanese stations were heard at very good strength in Eastern Australia and were popular with all listeners as they sent out very colorful verification cards. In addition to the cards, they usually forwarded a rather comprehensive questionnaire, and asked that the details requested be sent to them. While most of this information was harmless, there were one or two items which, if answered correctly, no doubt proved of value to Japan in later years. If they again send out these forms we personally think listeners would be wise to ignore them.

Here is the schedule which is now in operation.—

To North America: JOB—6.069 mc, 3 pm to 4 pm.

To North China: JOA—7.18 mc, 9 pm to 10 pm; JOB—6.069 mc, 9 pm to 10 pm.

To Central China: JOA—7.18 mc, 10 pm to 11 pm; JOB—6.069 mc, 10 pm to 11 pm.

To Philippines and Indonesia: JOA2—9.075 mc, midnight to 1 am; JOB 2—11.705 mc, midnight to 1 am.

To India and Pakistan: JOA2—9.075 mc, 1.30 am to 2.30 am: JOB2—11.705 mc, 1.30 am to 2.30 am.

RADIO GOA—Portugese India

THIS rather elusive station has now extended its service and is currently operating on a new outlet of 17.89 mc. Our good friend Art Cushen in New Zealand tells us he hears them at very good strength on this channel with their request program in English from 5.30 pm to 7.30 pm. On Sunday, they do not have an English program, but give Hindustani music instead. At 9.30 pm they announce in Portuguese, "Attention Goa—Radio Emisora Goa." This station also transmits from 11.30 am to 12.30 am in the 16, 31 and 49 metre bands, the other frequencies being 9.61 mc and 6.023 mc. Reports are requested on these transmissions and from our own experience we know they do send out a very nice verification, which will be a new country to many listeners.

FLASHES FROM EVERYWHERE

Germany: From various sources we gain the following information regarding German stations which are currently on the air. The Nordwestdeutcher Rundfunk at Norden-Osterloog operates on 6.27 mc from 6 pm to 8 pm, 7.29 mc 2 pm to 1.50 am, 1.51 am to sign off; 11.795 mc 3 pm to 1.50 am, 1.51 am to sign off; 15.275 mc 2 pm to 8 pm, 9 pm to 10 am; 17.815 mc 4.20 am to sign off; 17.845 mc 2 pm to 4 am. The Suddeutcher Rundfunk at Stuttgart uses 6.03 mc from 3 pm Sunday to 10 am Monday, from 2 pm on Thursday and Saturday to 10 am the next day, and other days from 2 pm to 9.5 am the next day. Munich is on 6.16 mc from 2.30 pm to 7.20 pm.

YUGOSLAVIA: Radio Australia received advice from a listener in Yugoslavia that Radio Yugoslavia is now using a 10 kw transmitter on five frequencies. A new 100 kw transmitter is expected to be on the air by May 1. The news broadcasts on the present station are 4.30 pm to 5 pm Spanish, 5 pm to 5.15 pm French, 5.15 pm to 5.30 pm English on 11.895 mc; 2.30 am to 2.45 am English on 7.24 mc; 4.45 am to 5 am French, 5 am to 5.15 am English on 7.22 mc; 6 am to 6.30 am Spanish, 8 am to 8.15 am and 9 am to 9.15 am French on 6.1 mc; and 9.15 am to 9.45 am Spanish on 6.225 mc. There is also a transmission in Russian at 9.45 pm on 11.73 mc and one in Greek at 10.15 pm on the same frequency. No mention is made of any broadcasts in the 31-metre band.

ETHIOPIA: In a recent issue of Sweden Calling DX-ers and also from Graham Hutchins' session from Radio Australia, we learn that the Addis Ababa station ETA has been logged on 9.624 mc and also on 6.422 mc from around 2 am till leaving the air at 4.10 am. The Voice of Ethionia is also using 15.047 mc from 2.30 am till closing at 5.15 am, and is quite good strength on some days. On some occasions we have also heard ETA using their 9.624 mc outlet from as early as 12.30 am, though it would appear that 2 am is the normal time for opening. The 15.047 mc channel suffers a considerable amount of interference, but the strength of signal is usually sufficient to overcome this disadvantage.

UNITED NATIONS: It is some considerable time since we received any direct information from the Radio Division of the United Nations at Lake Success and we were therefore pleased to see by the Swedish information sheet that details are still being sent out. It would appear that the broadcast to Europe is over WRCA 11.775 mc and WBOS 15.21 mc Tuesdays to Saturday from 4 am to 6 am in English, French, Arabic, Danish and Dutch. The United Nations Information Service in Geneva, Switzerland, broadcasts UN news on 6.672 mc in English at 4.30 am and in French at 4.45 am to 5 am. This broadcast can also be heard in parallel on 7.625 mc. The transmissions to the Far East can of course still be heard in the 31-metre band at 5.30 pm.

KENYA: Various listeners report that the Forces Broadcasting Station, which was formerly located at Mackinnon Rd., has recently been moved to Nairobi. A South African listener, writing to Graham Hutchins, advises that the station is using 7.265 mc from 1 pm to 3 pm on weekdays. Kenneth Boord, in the USA, reports hearing them opening with a fanfare at 1.59 pm and giving the BBC news at 2 pm. Other reports give the schedule of this station as weekdays 1 pm to 3 pm, 7.30 pm to 6 am, and on Sundays from 2 pm to 6 am on Monday. This station has been logged in Sydney around 5.30 am on more than one occasion. To complicate the matter still further, the station themselves state that they are only operating on medium wave at present.

ARGENTINE: The SIRA in Buenos Aires have just sent us their latest schedule, which reads as follows.—LRA 17.72 mc 1.30 am to 3.30 am to Brazil; 3.35 am to 6.30 am in French. On 9.69 mc from 7 am to 5 am in German and back on 17.72 mc in English from 8 am to 11.30 am, and finally in Spanish on 15.345 mc from noon to 4 pm. LRU transmits on 15.29 mc from 4 am to 5 am in Spanish, 5 am to 6.45 am in English, noon to 2 pm in Spanish and 2 pm to 4 pm in English. LRS uses 11.88 mc for all their transmissions, which are 11 pm to 4 am in Portuguese, 4 am to 5 am in English, 5 am to 6 am in Swedish, 6 am to 7 am in Italian, 7 am to 8 am in German, and lastly, from 8 am to 1.30 pm in Portuguese.

STATION ADDRESSES

APK—Radio Pakistan Headquarters, 71 Garden Rd., Karachi, Pakistan.

HS8PD—National Broadcasting Station, Publicity Department, Bangkok, Thailand.

YDO—Radio National Indonesia, Sudimaran 6, Bandjermasin, Borneo.

YI5KG—Iraq Government Station, Radio Baghdad, Baghdad, Iraq.

WARSAW—Polskie Radio, Noakowskiego 24, Warsaw, Poland.

TIFC—Radiodifusora, TIFC, Apartado 1307, San Jose, Costa Rica.

COBC—Radio Progreso, San Jose Num. 104, Habana, Cuba.

TGTQ—Radio Internacional, Sa. Avenida Sur 9 Guatemala City, Guatemala.

XEFT—La Voz de Vera Cruz, Independencia No. 74, Vera Cruz, Mexico.

YSUA—Radio Mil Cincuenta, Avenida Sur No. 50, San Salvador, El Salvador.

SHORT WAVE notes for the June issue are due on May 10. For the July issue they are due on June 7. Please send them direct to Mr. Ray Simpson, 80 Wilga St., Concord West, NSW.

SHORT WAVE REPORTS

When sending reports to short-wave stations with the idea of collecting verification cards it is important to give as much useful information as possible and, at the same time to be as as concise as possible.

There are two main purposes behind such reports, i.e., to establish the identity of the station beyond all doubt and to provide the technical staff of the station with as accurate a report as possible on the strenth and general quality of their signals.

A pamphlet on the collection of verification cards is available through our query service, price 1/-.

THE HAM BANDS WITH BILL MOORE

PROSPECTS BRIGHT FOR THE NEW 21mc BAND

The new 21MC band should soon be available to amateurs throughout the world for operation. Roger Mace W6RW, late in March, supplied the news that this band would be open to American amateurs from May 1st. This fact was confirmed by other stations.

IT is certain that some months will elapse before all administrations grant this frequency band to their amateur stations. In most cases the 3.5, 7 and 14 Mc bands are also affected, and the necessary organisation will take some time.

At Atlantic City, the world, for purposes of frequency allocations, was divided into three zones, and the width of the HF bands to be made available to amateurs in different countries, varied considerably under the agreement.

The Extraordinary Administrative Radio Conference, held in Geneva last year, was responsible for the arranging of the lower part (below 27.5 Mc) of the Atlantic City frequency allocation table, and their decisions will shortly be published.

According to reports, the plan can be summarised by stating that, below about 2850 Kc, the table will be brought into force by the transfer on certain dates of all services (except amateur) to agreed frequencies. Above 2850 Kc the changes will be made over a number of years.

Amateur allocations have been left to the various administrations and, provided the granting of frequencies is in accordance with the Atlantic City radio regulations, they apparently can be made at any time.

We should shortly learn from the PMG's Department of our new frequency allocations on the HF bands.

NZ QRP CONTEST

AUSTRALIAN amateurs are cordially invited to participate in the NZART's annual QRP contest, which will be run on the 3.5 Mc band during May.

The NZ winner will receive the Sangster Shield, presented in 1927 by Mr. R. Sangster, to New Zealand amateurs for annual competition.

Bob Dixon, ZL3JT, supplied the following rules, via the 3.5 Mc band.

The contest will be run for periods on two days, May 24th and 25th, between the hours of 1700 and 2200 hrs East each the hours of 1700 and 2200 hrs EAST each

Operation is limited to CW on the 3.5 Mc band only. New Zealand stations will be permitted to use a power input not in excess of 5 watts.

Six-figure serial numbers should be exchanged, and consist of the outgoing RST report, plus three figures, representing the number of the contact. The numbering of contacts may commence anywhere between 001 and 300.

Logs should be posted to reach the Contest Manager (ZL2GX), 86 Lytton Rd., Gisborne, New Zealand.

As Australian stations will provide most of DX for the low power NZ participants, please give them a call.

Licensing conditions for amateur stations in New Zealand vary somewhat from those applicable in Australia. Of interest to most VK's will be the requirements for high frequency permits (allowing operation on bands higher than 3.5 Mc), operating over there.

The qualifications and method of issuing were varied slightly from January 1st, and the following is a resume of conditions covering the granting of permits:—

Requirements for CW operation: (1) Applicants to have had at least one year's operation in the 3.5 Mc band, and to have had at least 50 QSO's therein. Log-books must be produced for inspection. (2) Applicant to be able to send and copy morse code correctly at a speed of 15 words per minute. (Four examinations will be held yearly.) (3) Station to be equipped with a suitable monitor, and an accurate frequency meter. (4) The power supplies used to be adequately filtered. The note must be pure DC and sharply tunable.

(5) Applicants to have a good knowledge of the "Q" code.

Amateurs desiring to operate on telephony are required to satisfy the following additional requirements:—

(a) Crystal control of the transmitter or alternatively a VFO having a tolerance of .02 pc or better, must be used.

(b) Transmitters must be so designed that there will be no possibility of frequency instability or frequency shift, when modulation is applied to the modulated stage.

(c) Stations to be equipped with a suitable overmodulation indicator.

The new high frequency permit issued this year will allow the holder to use the 14 Mc telephony allocation plus other allowable operating frequencies.

Holders of the old type of HF permits have to apply to the GPO for 14 Mc telephony facilities.

Previously, NZART testing officers had conducted the special 15 words per minute morse tests, now when applicants sit for their initial examination, they can sit for a 15 wpm tests as well as the normal 12 wpm examination. No further morse examination is required for a HF permit, if such permit is acquired within two years.

Holders of high frequency permit can be called upon at any time to show that they are proficient in morse operation at 15 wpm, sending and receiving.

SLOW MORSE TRANSMISSIONS

SLOW Morse transmissions, conducted by the Royal New Zealand Air Force Main Signals Centre, can be of value to prospective amateurs. Details of these transmissions are as follow:—The call-sign used is ZKF, and frequencies of 6000 Kc/s and 3320 Kc/s are used simultaneously; all transmissions are tone modulated.

Transmissions are radiated daily at the following speeds and times: 5 wpm—1700 hours EAST, 10 wpm—1715 hrs, 15 wpm—1730 hrs, 20 wpm—1745 hrs, 25 wpm—1800 hrs, 30 wpm—1815 hrs.

At more suitable times for Australian listeners, the three slower speed transmissions are repeated on Monday to Fridays, inclusive:—5 wpm 1830 hrs EAST 10 wpm—1845 hrs, 15 wpm—1900 hrs.

Reports on the transmissions can be forwarded to The Air Secretary (Attention Main Signals Centre), Air Department, Wellington, C1.

WIRELESS INSTITUTE NEWS

DELEGATES and observers and the Federal executive, in attendance at 22nd annual Federal Convention of the WIA, held in Sydney during Easter, were extremely busy, debating and deliberating on the agenda paper of 72 items.

The decisions reached can have important bearings on the future of amateur radio, and it is appreciated that so many amateurs are willing to forgo their Easter holidays in the interests of the hobby.

Of the many and varied subjects submitted for decision by the divisions and Federal executive, the following are some of general interest.

It is suggested that in view of rising costs Federal conventions be held bi-annually, and also that the Federal executive be located in Sydney for a period.

Various items affecting the National Field Day were submitted, and, as FE suggests, operation should be fully supported in view of the possible future requirements of civil defence.

That the Ross Hull Memorial Contest rules be varied to incorporate other VHF bands besides 50 Mc/s, and that a certificate be issued to all stations who have confirmation of 100 contacts on the UHF bands.

The Federal executive suggests that an annual Federal award on the decision of the Federal council be made to an Australian amateur, for work in one or more of the following fields:—

(a) The design and construction of an outstanding piece of equipment.

(b) For outstanding service in the sphere of emergency communications.

(c) For contribution of the greatest service to the advancement of his division. The recipient to be selected from the six divisional winners.

The subject of issuance of a Worked All Australian States Certificate also be considered, as should the desirability of giving full publicity to suggestions for the renewal of QSL-ing all contacts.

That the WIA should negotiate for copyright to publish an Australian Amateur Station Call Sign Book. The NZART publishes a similar callsign book in New Zealand.

The subject of novice and technical licences, similar to those issued in the US, was discussed, as was a suggestion that television facilities be the subject of a request to the PMG's Department.

The following licence matters were also discussed, the raising of power from 100 to 250 watts, the reduction of the age limit for amateur licencees to 16 years and the transmission of music on 50 Mc/s and above.

In due course, after the publishing of official minutes, the results of the deliberations will be known, and during the year the Federal executive will take the necessary action to implement these decisions.

The annual meeting of NSW Division's UHF section was held during April and the following officials were elected: — President, John Miller, XK2ANF; vice-president, Keith Alcock, VK2AO; secretary, Harry Solomons, VK2AJZ; management committee, Horry Lapthorne, VK2HL; Bill Macgowan, VK2MQ; and Bob Winch, VK2OA.

The section's 144 Mc autumn field day was held on Sunday, April 6th, and competitors were required to locate by cross-bearings a number of stations in secret locations.

The new AOCP class of the WIA's NSW Division commences on Monday, May 5. Information on the class, which is held in Sydney, can be obtained from the class manager, Box 1734, GPO, Sydney.

The venue of the Hunter branch's May meeting was the 2HR Auditorium, Maitland, when State president John Movle, VK2JU, lectured on "Microgroove Recording." Under the chairmanship of Lionel Swain, VK2CS, the meeting was well attended, and visitors from Sydney included the State secretary Dave Duff, VK2EO, Maurice Butler, VK2ANN, and Harry Powell, VK2AYP.

GENERAL NOTES

The following notice was published recently in the Exchange and Mart Section of the RSGB Bulletin, "Bachelor Ham (42), would like to meet YL interested in hobby. West London area." It would ap-

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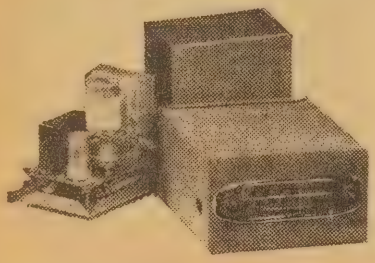

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DELEGATES AT W.I.A. CONFERENCE

Delegates from all states met in Sydney over the Easter weekend for the annual convention of the Wireless Institute of Australia. This photograph was taken during the second session on Easter Saturday.

pear that the amateur concerned is determined to start out in the right way and hopes to be assisted rather than retarded.

Visitor to NSW during April and May was Fred Leader, from New Zealand. Fred, now 77, was extremely well-known to VK and NZ 80-metre operators in the 1930s, and provided many stations with reports. "The Monitor," as was Fred's cognomen, will attend the North Coast's annual convention and visit various NSW amateurs.

The 3.5 Mc band again provided some interesting DX during second weekend of the W/VE DX contest. Plenty of distant stations were audible, although they were not so easily contacted as during the first session.

It is perhaps hard to imagine that a "dog pile" of W stations would ever be heard on the 3.5 Mc band, but such did occur. At about 1745 hrs EAST on the Saturday, HC2OS at RST 558 appeared on 352 Kc and within five minutes his frequency was a mass of squealing W stations. It was apparent that 3.5 Mc W station operators could learn little of high pressure tactics from their 14 Mc colleagues.

Some W7 stations were running at S8, while KG4AF, KZ5CS, KS6MG and plenty of KH6s were also heard.

ITALIAN FLOODS

The full story of the extensive work of Italian amateurs during the recent devastating floods in the Po Valley, has not yet been told. From the little information gleaned, amateur operators maintained communication for national, municipal, Red Cross and fire brigade authorities. The 7 and 144 Mc bands were used extensively, and communication was maintained with a government station located in Rome.

The fact that no emergency organisation existed prior to the floods provided a disadvantage, according to amateurs participating in the work. Similar experiences were noted during the Jamaica hurricane of last year and clearly pointed out that some skeleton scheme was at least required.

The success of the first IARU (Region 1—Europe) 144 Mc contest, run by the Dutch National Society, has indicated that the contest should be an annual event. It provided amateurs in Europe with an opportunity to study propagation conditions on that band, and one contact by DL4XS/3KE with GW2ADZ, over a distance of 550 miles was recorded. 15 contacts over distances exceeding 300 miles weremade during the four weeknds, in fact, all these contacts were made on the one day, when conditions proved favorable.

120 stations in eight different countries participated, and communicaton across the Medterranean ,between France and Algiers, was established on several occasions.

The winner was G3BLP, who ran 120 watts to a pair of 826s, and used a 16-element stacked array. The receiver consisted of 6AK5 and EC91 RF stages, 6AK5 mixer and IF stages at 28 Mc.

VETERAN HAM

LIKE some old soldiers, radio hams refuse even to fade away. One of them, a pioneer of radio and the first man to operate a broadcasting station in Australia still carries on, despite a weak heart.

He is Charles Dansie Maclurcan who, in a life of intense speed and diversity has been garage proprietor, car importer, electrical engineer, model maker, boiler attendant, sailor, photographer, philatelist, skier, figure skater, hotel proprietor, motorcyclist, historian and businessman, and has succeeded in all of these jobs.

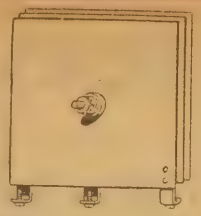
His activities in radio which include successful radio telephoning when professionals failed, are described in his vividly written life story featured in the current issue of PEOPLE. This is a story packed with interest for hams as it delves into the history of amateur radio in Australia.

PEOPLE is available at newsvendors, price 1/-.

DESIGNER'S HANDBOOK

WE are advised by the publishers, Amalgamated Wireless Valve Co. Pty. Ltd., of 47 York St., Sydney, that the new fourth edition of their Radiotron Designer's Handbook is now in press and is expected to be on sale in July. The book consists of 1500 pages comprising 38 chapters with over a thousand illustrations and will sell for 55/- per copy. The editor, Mr. F. Langford-Smith, BSc, BE, is well-known throughout the radio world for his technical articles and authorship of earlier editions of the R.D.H.

BRAND NEW ENGLISH RECTIFIERS



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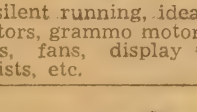

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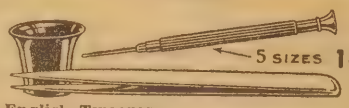

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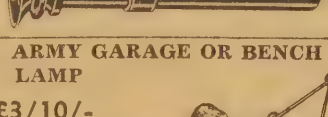

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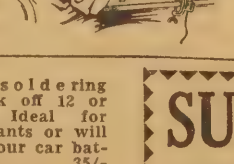

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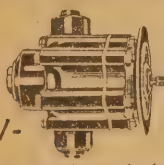

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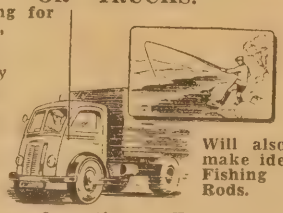

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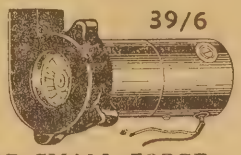

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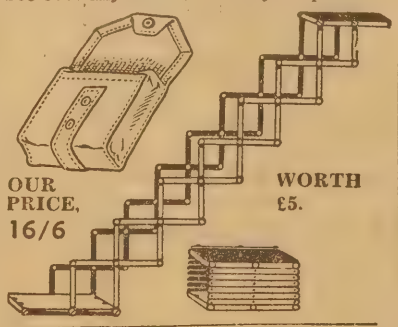

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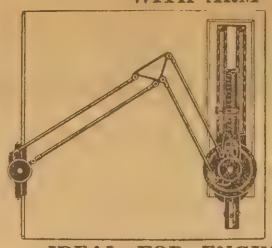

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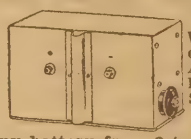

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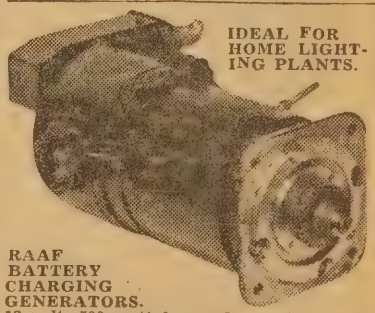

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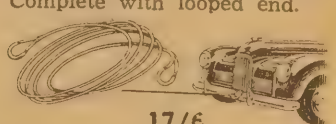

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OFF THE RECORD — NEWS & REVIEWS

During the month, I spent a most interesting morning watching the Sydney Symphony Orchestra conducted by Goossens making records for EMI in the Great Hall of the Sydney University. When completed, these records will be placed on the world market—the first Australian venture of its kind.

By JOHN MOYLE

AT first glance, the Great Hall seems too narrow and high for good acoustics. To reduce its length, the rear was curtained off to make a recording chamber at the front about half the size of the hall. The unused portion was filled with ordinary chairs as though awaiting an audience which had forgotten to come.

These damped out possible reflections from the hard flagstones. The stone walls of the hall are closely hung with numerous portraits in oils, which again served to break up the echoes. And the ceiling, although high, is actually the inside of a steeply gabled roof, and has no horizontal reflecting surface at all.

The final result gave a recording studio with quite attractive characteristics. It was lively and bright but without any objectionable or exaggerated reverberation. Two microphones were used, one on each side of the conductor and slightly behind him. These ran to a pair of independent mixers on the recording panel.

As the orchestra began to assemble, I could not help being struck by the color of the general scene. The area to be occupied by the orchestra was lit by four overhead floodlights, which plunged into gloom everything outside their pool of light. From the portraits on the soft-colored walls, reds and blues jumped out, added to by the players themselves as they came to their places.

COLORFUL SCENE

High up and outside the gloom, stained glass windows floated in the air, their colors softened into tapestry carpets of light. Here and there the light glinted on brass, or flashed from the varnish of a violin. Add to this the hum of talk and interplay of notes from practising horns and woodwind.

Later I stood in the semi-darkness of the entrance hall beside awesome structures which normally contain double basses and harps, watching the orchestra playing. The dignified statue of William Charles Wentworth surveyed the scene from the left, and that of John Henry Challis with outstretched hand saluted all and sundry from the right.

I rather longed for a color camera although it could not have done justice to the blending of light and sound.

The recording equipment was located in a small ante-room off the entrance hall. Here two Emitape machines made duplicate "takes" of the performance. When not recording, the microphones fed directly to a monitoring loud speaker on a large baffle so that everything in the hall could be heard. When ready to record, the engineer sounded a single buzzer in the hall as a warning, followed by two more when all was ready to begin.

Sometimes stray traffic noises delayed the start. Once a passing aircraft called for a complete replay. But on the whole, conditions were much better than in the other halls which have been used in the past.

There was something strangely unreal about the atmosphere. This was no rehearsal, but a full performance, with no audience except the tape recording machines which caught every sound with deadly accuracy, and the group of technicians which attended them. The players and conductor were watchful and maybe a little anxious, particularly the section leaders, several of whom had solo parts in the music being played.

SEVERAL RECORDINGS

The machines, however, were recorders, not critics. They didn't mind how many times the music was played and replayed, until each "take" was pronounced perfect. The anxiety if any served merely to tune everyone to concert pitch, for, if they weren't satisfied the first time, they could always try again.

Thus, performances similar to the one I witnessed took place day after day until the full recording schedule was completed. There was an air of craftsmanship about it, the shaping of outlines with infinite care, the checks back to make sure that each significant phrase had been caught by the microphones with just the right turn and power.

Playing for the record isn't the same as playing to an audience. The microphones must try to be all ears to all people, and the recording engineers must strive always for the near impossible — to catch all the music all the time.

It was a fine demonstration of a point I have often made, that recordings represent an entirely different method of hearing music. To move from the recording hall to the monitoring room was to appreciate this. We just can't hope to make any orch-

estra sound in our own homes as it does in a large hall. We must set about creating something quite new in listening, through a method which, by its very difference, has quite a few advantages over the actual performance.

It brought home to me also the importance of just being at a concert in the atmosphere of performance and of people. We can't have this when listening to records, but we do have other things which take its place.

The recording engineer was Mr. Arthur Clarke, an EMI veteran of 45 years' service in the recording field. He is a quietly spoken man, a little below average in height, but just as alert and keen on his work as in the days of Caruso, Melba and many other stars of the early century. He has a stock of stories and experiences to tell of the changes he has seen over the years, but our conversations dealt more with technical and similar aspects of recording as he went about the job in hand.

Despite the modern method of recording performances on high-grade tape, Mr. Clarke, to quote his words, is still "a wax man at heart."

"You can read a wax," he said, "but you can't read a tape."

TAPE LOSSES

He agrees with the opinion sometimes expressed that a wax recording is superior to the process of taking it down on tape, editing, and then transferring it to the wax. He thinks it unavoidable that something of the original must be lost with each different handling.

I gathered that his objections were more on aesthetic than technical grounds, although he pointed out that the use of the tape added to the work of the recording engineers, whose ultimate aim must be to produce a finished wax ready for the plating baths, no matter what means they used to get it there.

As a matter of interest, he explained a point which had not occurred to me before. One would imagine that, when recording for long-playing purposes, the obvious thing would be to record a complete work or a movement from a work without a break. This, in fact, is rarely done. The reason given is that, whereas small blemishes in a concert performance might be tolerated, and in fact can't be avoided, they are intolerable in recording. It would be a superhuman job to ensure that, from both a musical and recording angle, 20 minutes of performance could be obtained without a flaw.

PROVISION FOR LP'S

Although EMI is not yet producing long-playing records, they are obviously keeping the possibility in mind. For these recordings, therefore, while they are made in takes of about four minutes 20 seconds each, a few bars including the break are recorded separately, so that should it be desired to produce a long-playing version, this small section can be used to join the corresponding takes to preserve continuity.

It was quite fascinating to see the recording engineer speaking into the microphone the appropriate identification for each take and bridge piece, so that, when editing, the cutter can sort out all the pieces for final assembly, just as is done with motion pictures.

This little piece, of course, is said before the recording begins, and everyone settles down to give the "ready" signal to the conductor.

After each section of the recording was made, Eugene Goossens, the leader of the orchestra Earnest Llewelyn, and the leaders of the various sections trooped to the recording room to hear it played back. The conductor sat with his score checking each point as the music was played, noted whether a woodwind was a little off key, a violin solo too prominent, or a harp not sufficiently forward.

Maybe the side would be recorded two or three times, with small adjustments of this kind made each time until the conductor was satisfied that the tape had indeed taken down just what he intended.

CONDUCTOR'S CARE

When ultimately you buy these records, you might remember the meticulous work which went into their making, for together with his many fine qualities as a conductor, Goossens is meticulous, and a fine orchestral teacher. It was of the greatest interest to me to observe a little of his methods, not only while actually conducting the orchestra, but in listening for the effects he had been striving to produce on the tape.

All this time, Mr. Clarke had been performing similar duties from his own angle. He shared conferences with Goossens on how to ensure that the harp was placed so that it could be heard, or whether it would be best merely to play a little louder than would be done, for instance, in the concert hall.

While the recording was being made, he was seated at the control panel, his hands working carefully on the faders to each microphone, preserving the balance all were striving for, and making sure that the over-all recording level remained constant from take to take, and for that matter, from day to day.

MONITORING FACILITIES

To help him, he had brought out a special volume level indicator consisting of a specially damped meter connected to compensating circuits which allowed for the characteristics of the recording curve being used.

To do this, the monitoring loud speaker was reproducing not directly from the hall, but from the actual tape on which the recording was made. The switchover from direct pick-up to tape was made by the technician in charge of the two recorders a few seconds before the recording began. The recorders are fitted with a special playback head which feeds the music to the loudspeaker a fraction of a second after the recording head has energised the tape. Thus we were hearing through this speaker the recording itself, almost at the instant it was made.

I was most impressed both with the recordings themselves and with the performance of the orchestra which made them. As my readers will agree, recordings are deadly things. From my own experience I know just how awful a live performance can sound when recorded, even when direct listening seems to indicate that the performers were doing quite a good job.

As Goossens and others have said, Australia can view with pride the standard of the Sydney orchestra, and need have no fears that it will not stand comparison with many famous

(Continued on Page 112)

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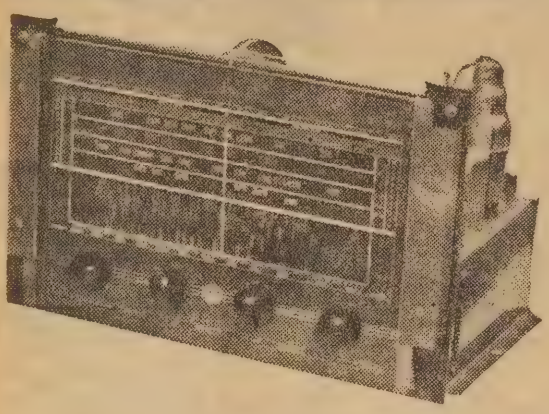

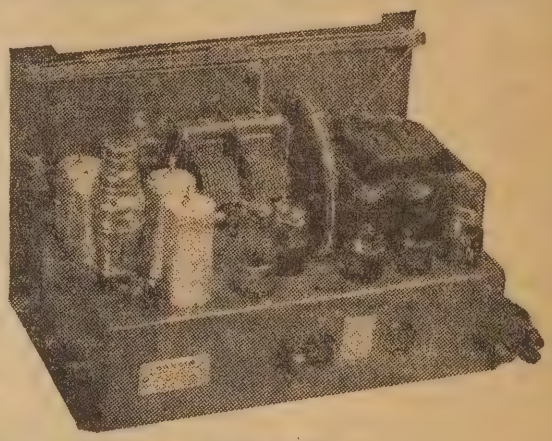

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CLASSIC RADIO

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Mantel Set

(Continued from Page 88)

of its travel as the tuning gang is turned from one extreme to the other. Set the bottom slug of the IF transformer at about half-way out and the top one almost fully out. This precaution is taken so that the iron slug does not unduly affect the coupling between the feedback winding and the grid winding. Set the 50 pf feedback capacitor about half-way in, a position which would normally be below the point of oscillation.

Now connect the aerial and see if you can tune in a local station near the high frequency end of the tuning range. In Sydney, station 2SM can serve as a marker. Peak the trimmer across the aerial circuit gang section for loudest volume.

Peak both slugs in the IF transformer. Now slowly screw in the 50 pf feedback capacitor. The volume will rise until a stage is reached where the set squeals. Back off the trimmer about one half turn. Re-adjust the slugs in the IF transformer. You may now find that you can get a better adjustment of the feedback capacitor. For every adjustment of the feedback capacitor close to the optimum position, you will need to re-adjust the slugs in the IF transformer.

OSCILLATOR TRIMMER

Check the dial to see if the station is being tuned in at the correct position. If not, adjust the trimmer capacitor across the oscillator circuit gang section until it does. For each adjustment of this oscillator trimmer, re-adjust the aerial section trimmer.

Now tune in a local station near the low frequency end of the dial. In Sydney, station 2FC is a handy marker. Adjust the slug in the aerial coil for loudest volume. If the station is not being tuned at its correct spot on the dial adjust the slug in the oscillator coil until it does. For each adjustment of this oscillator coil slug, re-adjust the aerial coil slug.

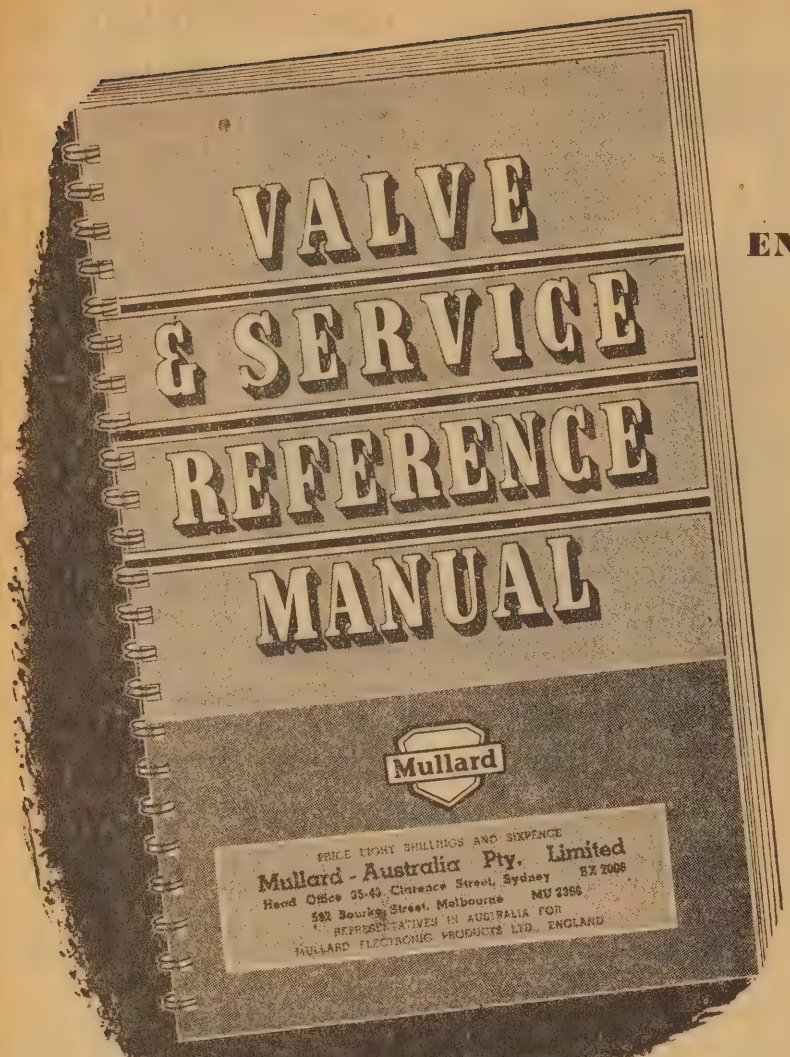
For all these adjustments, keep the volume turned down so that any changes in the level can be detected easily.

The next step is to go over the adjustments to the IF transformer slugs and the feedback capacitor. Follow this by tuning in the previously selected station at the high frequency end of the dial and check the adjustment of the aerial and oscillator trimmers in the manner outlined.

You will notice that when the feedback capacitor is set too close to the position for actual oscillation in the detector circuit, there will be a pronounced hiss or "swish" as you tune across a station. Naturally, the most desirable setting of the feedback capacitor is when maximum sensitivity is obtained without this excessive hiss.

All this discussion on the alignment procedure may tend to make it sound complicated. Actually it isn't. After your first attempt you will get the feel of the adjustments and it is then only a matter of putting the finishing touches to it.

Incidentally, if you use a 6SN7-GT, you may need to add about 10 pc more turns to the feedback winding. Alternatively, you could use a 50 pf fixed capacitor in parallel with the 50 pf feedback capacitor to provide the additional feedback.



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MR5-52

FROM THE SERVICEMAN WHO TELLS

(Continued from Page 55)

was about to tackle the underside of the chassis when the signals failed almost completely, leaving only a faint distorted signal with a severe hetrodyne on it.

Tuning over the band brought forth a strong hetrodyne at each station position, making it obvious that the set was oscillating badly.

Tapping the valves again brought no result but when the IF valve was moved in the socket there were sundry crackles and a general impression of touchiness. I did not overlook the possibility of a faulty valve socket or a dry joint in a base pin, but I also noticed that when the valve was moved, several components around the socket also moved (several blank pins on the socket had been used as anchor points) and I wanted to check these before the fault was disturbed in any way.

A GENTLE TOUCH

For the benefit of the uninitiated I might add that this job calls for a certain amount of care. It is not sufficient to simply wallop each component in turn, for it is most likely that the vibration will be transferred, through the chassis or by other means, to the faulty component wherever it may be, thus completely clouding the issue.

To avoid this it is necessary to develop a very light tapping technique, sometimes amounting to no more than dropping the end of a pencil about an inch or so on to the suspected component. Each probable offender should be treated in the same manner and if none show any response the whole process should be repeated with a little more force, and so on until there is some evidence of noise.

Even then it may be difficult to differentiate between adjacent components and it can often only be done by noting which makes the most noise when they are all struck with approximately the same force.

So it was in this case, and I eventually pinned the maximum noise down to a .05 paper condenser bypassing the AVC line. When I felt reasonably confident that this was the offender I administered a couple of severe wallops in an effort to restore it to normal. With the second blow it came good and the set played normally, but when the condenser was subsequently struck the speaker gave forth a metallic ring, exactly as if the condenser had been a microphone.

VARIABLE RESISTANCE

Needless to say a new condenser cleaned up the trouble, but it is rather interesting to observe just how touchy these components can get. In this case there was obviously an intermittent open circuit between one of the pigtails and the metal foil, but apparently, even when the circuit was "closed" there was still a high resistance between the two points and this varied with mechanical vibration and pressure in exactly the same way as do the carbon granules in a microphone. Hence the microphonic effects at high volume.

Finally, I noticed that the screen resistor to the audio valve was getting rather black in the face and a check on the screen by-pass condenser showed that this was leaky. While the set-up had continued to function, it was obvious that it was only a matter of time before the resistor disintegrated into a charred mass.

A new condenser and resistor were fitted, the set given another general once-over, including alignment, and I was able to return it to the customer confident that another intermittent had "bit the dust."

MULTIMETER

(Continued from Page 49)

place. We laid the three 703's flat on the bottom of the case, along one side, and held them in place with an aluminium strap laying along the top of them and anchored at each end. The 950 cell is held against the opposite side with a small, semi-circular aluminium bracket screwed to the side of the case.

And that is about the end of the multimeter story, except to say that, made according to our instructions, it should be equal to a commercial instrument costing much more than your outlay on parts and, at the same time, giving you the satisfaction of saying, "I made it myself."

Readers say:

SPEAKER HORN

Re small cubical speaker horn as described by you in Radio and Hobbies (Dec.). I have just constructed one of these and I am very pleased with it. It does everything asked of it.

I didn't use an 8" speaker. Instead I used a Rola 6" taken from a Kriesler 5 valve late mantel model. This same set, of course is feeding this speaker horn.

I am so much taken with this horn that I intend to construct another, but this time I would like to use the speaker as you mentioned, 8" extended range type.
—A.H.D., Queenstown, Tas.

★ ★ ★

First, may I offer my congratulation to John Moyle and R & H for the Playmaster series of amplifiers and tuners. I have built the 10-watt Playmaster and No. 1 Control Unit and am delighted with the performance. As my object was the faithful reproduction of recording from the purely musical angle, my success has been 100 pc.—A. N. McC. (Kingwood, Victoria).

★ ★ ★

I note with interest, your picture of "The World's Smallest Car" in the January issue of Radio and Hobbies.

This car was exhibited in Krefeld, Germany, when I was there on holiday in September 1950. Being myself a midget-car owner, which by the way I had with me at the time, touring the Continent, I was very interested, and remember well, some of the specialities.

My own car was a Bond Minicar, and I compared my data with the German Salesman, which is as shown below.

The German car had full sized wheels, whereas the Bond used very small two-piece wheels, with 2-ply wheelbarrow tyres. The engine on the Bond was attached to the front fork, and moved with the steering which was operated by cable. The only springing I had was a 6" by 2" on the front. The back stub axles were bolted to the side of the body. The German car had coil springing on each wheel, and an orthodox type of steering. It was more roadworthy than my car, which by the way was of British Manufacture, but the finish of the German car was very poor.

The Bond by the way, took my wife and I, plus luggage (3 cwt. in all) 1200 miles from Portsmouth, England, to France, Belgium, Holland, and Germany, and then back again, including long stops, in eight days.

N. J. (East Corrimal, NSW).

SMALLEST CAR?

Price	*£135*	*£265 Sterling*
C.C.	*500*	*197 Villiers.*
Wheels.	*4.*	*3.*
Height.	*3'6"*	*3'0"*
Length	*8'2"*	*8'0"*
Petrol Cons.	*75 m.p.g.*	*100 m.p.g*
Weight	*3½ cwt.*	*3 cwt.*
Top Speed	*44 m.p.h.*	*55 m.p.h.*

ANSWERS TO CORRESPONDENTS

K.C.L. (Sarawak Borneo) wants to know where he can obtain books on watch and clock repairing.

A.: We have no details of any particular publications, but would suggest that you contact such booksellers as Angus and Robertson (89 Castlereagh St., Sydney) or Dymocks Book Arcade (424 George St. Sydney) and explain your requirements. Regarding a correspondence course covering this subject, we suggest you contact International Correspondence Schools Pty. Ltd., 140 Elizabeth St., Sydney.

J.K. (Dunskine Vic.) is newly arrived in Australia and wants to know if there are any amateur movements interest in short-wave radio which he could join.

A.: We suggest that you contact the Wireless Institute of Australia, Law Court Chambers, 191 Queen St., Melbourne C1. where we are sure you will find the type of organisation you have in mind.

J.S.T. (Oakleigh, Vic.) wants to know if it is possible to convert a car radio for use as a public address system. He also wants to know if it is possible to build a dual wave set for use in a car.

A.: It may be possible to attach a preamplifier to the audio section of a car set which would allow it to be used with a microphone, but we feel that a much better idea would be an amplifier specially designed for the job. We have several circuits of amplifiers designed for use with vibrator supplies and the one which would probably suit you best would be the Vibravox amplifier described in Radio and Hobbies for September, 1946. Copies of this circuit are available through our postal service. As far as we know there are no commercial car radios designed for operation on short waves, while there are many reasons why they are unsuitable for the home constructor.

L.H. (Melbourne, Vic.) sends a number of questions for the "Answer Tom" column including one about the shift of calibrations on his set when the aerial length is changed.

A.: It is most likely that your set only uses one tuned circuit and this is effected by the length of aerial connected to it. It would also seem that your tuning condenser is a little on the small side, otherwise you would be able to tune over a greater range. "A.V.C." stands for Automatic Volume Control, which is a system whereby the gain of the set is controlled by the strength of the station. At very high frequencies a short piece of wire can have considerable impedance and can easily upset the operation of a circuit. Bandspreading is a means of spreading a section of the frequency over the major portion of the dial.

Aerial peaking probably refers to the alignment procedure and in particular to the adjustment of the aerial circuit. Details of how to become a "ham" would be far too numerous to detail in these columns, but we may publish some details in the near future. Your letter has been passed on to the "Answer Tom" department for possible use at a later date.

W.B.M. (Box Hill, Vic.) is interested in tape recording and wonders when we intend to describe a tape recorder in Radio and Hobbies.

A.: Tape recording is a matter which we have had under consideration for a considerable time. However, the construction of a tape deck involves a good many purely mechanical problems and only a limited number of readers may have the necessary facilities to make a good one. We plan to describe a practical design just as soon as the mechanical and components problems can be solved to our satisfaction.

B.G. (Hutt, NZ) wonders why there is no power connection to the receiver described in the first instalment of the "Learn While You Build It" series.

A.: The receiver you mention uses a crystal detector to rectify the radio frequency energy received by the aerial. It is this energy received by the aerial that actually drives the headphones. No connection to either the power mains or batteries is required.

R.P. (Glenunga, SA) wishes to improve the high frequency response of an 8in speaker. The method he suggests is to cement a small aluminum cone to the voice coil after the style of some of the better class imported speakers.

A.: There are so many variable factors that we would not like to predict the results. In ideal cases it could have the results you desire but it is possible that the extra cone could cause serious resonances elsewhere in the range. The only thing we can suggest is that you try it and see. Be prepared to remove the extra cone if the results are not as hoped.

L.C.H. (Nutgrove, Q.) sends us a circuit of a transmitter and modulator for comment.

A.: Main objection to this circuit is the use of a V.F.O. from a variable voltage source, i.e., a genemotor, without any attempt to stabilise the voltage to this part of the circuit, and it would almost certainly be necessary to fit a voltage regulator valve. There is some doubt whether the valve to be used is really 6AG7 as this type is not normally available in Australia. It may be that a 6AC7 is the type intended, but in any case the 6SH7 is hardly a substitute for a 6AG7, the latter being a power valve. The modulator will probably be more than adequate as it is doubtful if you will be able to load the 807 to 24 watts under these conditions of operation. The genemotor should provide adequate power, particularly if the 6V6's are under-rated a little as they could afford to be. Starting the genemotor through a resistor would certainly make things a little easier for the battery.

H.F.F. (Koorboo, Q.) has built the dual-wave battery receiver described in Radio and Hobbies for June 1951 but disappointed in the results.

A.: From your description it is fairly evident that the set is not performing correctly, as it should have sufficient sensitivity to receive any signals which are audible above the noise level. You make no mention of alignment and we suggest that if this has not already been done that it be the first approach to the problem. If you do not feel competent to tackle the job yourself it would be better to enlist the aid of someone more experienced, such as a competent service mechanic. If the set does not respond to this treatment it is obvious that there is either a faulty component or wiring and again it may be necessary to enlist additional aid if your own checking fails to reveal the trouble. Normally the alignment procedure will give some indication of the performance of the set and the probable location of the trouble if it fails to come up to expected figures. The use of the incorrect speaker transformer will effect the undistorted power output but not the sensitivity.

M.R. (Bellingen, NSW) writes to advise us of a change of address and also to tell us of some of his set-building activities.

A.: Our subscription department has made a note of your new address and future issues will be posted accordingly. We are very pleased to note that you have found our designs so successful. The trouble with "Little Jim" appears to be somewhat of a mystery, but if it was due to a faulty component, apparently the component was not included in the "Little General." No doubt you will have found out "Learn While You Build" series a valuable addition to the correspondence servicing course.

E.S. (Bannockburn, Vic.) wants to install an "electric eye" in his garage door and is anxious to obtain some additional information about the types described in a recent reprint article.

A.: The article to which you refer was supplied by the engineers of the Aerovox Co. in America and was intended to cover general types rather than specific makes. There are various types available on the Australian market, though we know of no voltaic types. We understand that the Australian General Electric Co. 93 Clarence St., Sydney, market complete units comprising cell, relay and power supply which can be used for the purpose you have in mind. We suggest you contact this firm and explain your requirements. We may be able to do something about the reprint you suggest at a later date.

THE "RADIO & HOBBIES" QUERY SERVICE

ALL queries concerning "R & H," designs, to which a POSTAL REPLY is required, must be accompanied by a postal note or stamps to the value of TWO SHILLINGS.

For the same fee, we will give advice by mail on radio matters, provided the information can be drawn from general knowledge. UNDER NO CIRCUMSTANCES, however, can we undertake to answer problems involving special research, modification to commercial equipment or the preparation of special circuits.

Whatever the subject matter, we must work on the principle that a letter is too involved if the reply takes more than 10 minutes of our time.

Queries not accompanied by the necessary fee will be answered FREE in the columns of the magazine and presented in such a way as to be of interest to other readers.

To those requiring only circuit reprints, &c., we will supply for TWO SHILLINGS diagrams and parts lists from our files covering up to three "R & H" constructional projects. Scale blueprints showing the position of all holes and cutouts in standard chassis will now be 3/6. These are available for nearly all our designs.

Address your letters to The Technical Editor, "RADIO and HOBBIES," Box 2728C, GPO, Sydney.

Note that "RADIO & HOBBIES" does not deal in radio components. Price quotations and details of merchandise must be obtained direct from our advertisers.

J.P.F. (Bondi, NSW): Inquiries about circuits for beat frequency oscillators and wants to know whether anything along these lines has been published recently. He also wants to know what is a decibel meter.

A.: As you suggest J.P.F., the audio oscillator which we described in July and December 1949 has many advantages over the beat frequency oscillator, particularly as far as the home constructor is concerned. Since it is generally capable of doing just as good a job it has largely replaced the more complex B.F.O. The decibel meter is similar to an output meter except that it is calibrated directly in decibels (db), the unit of loss or gain. Many thanks for your kind remarks and we hope you continue to enjoy the magazine.

A.N. (Epping, NSW) wants to know the qualifications necessary to become a ship's radio operator.

A. You will need to obtain a first or second class radio operator's certificate before you will be in a position to hold such a position and we believe the minimum age for this is 18 years. However, you can obtain full details on application to the Radio Inspector, Wireless Branch, GPO, Sydney. In addition to morse code you will need a knowledge of radio receivers and transmitters and also the international regulations.

D.W. (Wagga Wagga, NSW) wants to know what type of pickup and turntable to use with the Baby Record Player described in Radio and Hobbies for August, 1950.

A. No special type of turntable is required because of the type of amplifier but the choice of pickup is important. As was explained in the original article, simple amplifiers like this are intended for use only with high output pickups of the crystal variety, very few, if any, of the magnetic types having anything like enough output. We are not familiar with the type of pickup used with the automatic record changer you mention and would suggest that you obtain full details from the agents before purchasing. The pickup used on the GU4 should be suitable.

A.J.W. (West Perth, WA) has built the Simple Record Player described in Radio and Hobbies for February, 1949, but, after fitting a 6SJ7 preamplifier, finds that the tone control will not work.

A. As no tone control was fitted to the original circuit and you do not explain how yours was fitted, we are at something of a disadvantage to explain your trouble. If fitted in the normal way, i.e. either from the plate or grid of the 6V6 to the chassis, there is no obvious reason why the addition of the preamplifier stage would affect its operation. If you care to let us have some more details we may be able to help you further.

O.S.B. (Penang, Malaya) is anxious to obtain further details of vented enclosures after reading some mention of them in the February issue of Radio and Hobbies.

A. A reprint of an article on vented enclosures which originally appeared in Radio and Hobbies for April, 1951, is available through our mail service, price 1/-. This contains much useful information on the basic principles as well as details of the dimensions for various speaker characteristics.

J.C.D.M. (Redwood, SA) would like some further details of the audio oscillator section of the service oscillator described in the "Reader Built It" page for March, 1952. Main point of bother seems to be the 15-watt globe in the cathode circuit of the second audio oscillator valve.

A. We are afraid that time and space will not permit us to delve fully into the theory of this type of oscillator but the general idea is that positive feedback is made to occur at one particular frequency while it remains negative at all others. This tends to eliminate harmonic distortion and such devices are normally capable of very good results. The purpose of the lamp in the cathode circuit is to regulate the audio output and maintain it approximately constant at all frequencies. Its ability to do this is due to the characteristic of the filament whereby its resistance increases rapidly with increase in temperature (or current flow). The idea is used extensively with devices of this kind.

Wanted to Buy, Sell or Exchange

FOR SALE: University Test Oscillator; 5 ranges, 170 Kc to 34 Mc. Guaranteed perfect order, £17. C. L. Hughes, 341 New St., Brighton S5, Melbourne. XB3453.

FOR SALE: Communications Receiver; 12 valve. Built round an Aegis KC 4 tuning unit, has a specially reinforced heavy steel chassis, B.F.O., Amplified A.V.C. Noise Limiter, 12" Jensen speaker on baffle. Outstanding performance and only six months old. Grey Metal cabinet. Price £80. C. L. Hughes, 341 New St., Brighton S5, Melbourne. Phone XB3453.

FOR SALE: Coils, valves, gangs, &c. Also radio magazines. For details, D. W. Rutland, Box 64, Colac, Victoria.

FOR SALE: Stamp collectors, my sets and singles for beginners or medium collectors are the "goods" in price and quality. Selections on request. N. Cleary, St. Andrews, Victoria.

FOR SALE: Henderson power trans. 385/385 150 mA; 2 Ferguson power trans. 385/385 80 mA and 285/285 60 mA; filament trans 240/6.3; 2 Henderson filter chokes 150 mA., Red Line Output trans. 12000 PP/8,2; Ferguson Output trans. 5000 PP/12.5,8.2.3. All items in excellent condition. Phone M. J. Pearson, UM6732.

FOR SALE: 30 copies R. & H. 1947 to 1949. 38 Bett St., Kogarah.

FOR SALE: 1, G12 Speaker. 1, K12 Speaker. S.H. Valves. Radio and Hobbies. S.H. Parts including transformers, resistors, condensers. Owner going abroad. F. Westerman, Lovel St., Katoomba.

FOR SALE: Axiom 150 mounted in vented enclosure. Sell complete £22. J. Arthur, UJ4052 after 8 pm.

SELL: Stromberg-Carlson record changer latest 78 crystal £14. XM7512.

SELL: Engineers books drawing board. 33 Hill St., Fairlight, NSW.

SELL: All R. & H's from 1st copy printed to the latest. What offers? A. W. Davis, Bellbrook, Via Kempsey.

SELL: 1 AVO Universal Bridge, new, faultless, £38 or offer. Valves, 1F5, 1G4, 1Q5, 1K5, 1K7, 6J5, 6SF5, 6H6, 76, 1T4, 1R5, 1S5, 3S4, 10/- ea. Var. Cond. AWA min. 2 gang. 1 midcap 2 gang, 10/- ea. 1 single gang, 1 microdenser & 1 UHF 2 gang, 5/- ea. Efco msl 48 dial, 12/6. Loop antenna, 10/-. Coils: 1 osc. 7/6, 1 reinartz 5/-, 2 I.F. 2/6 ea. 1 Rola 3" spkr. & trans. 12/6. New Jensen 7" 35/-. 1 Audio trans. 30-10,000 cycles, 22/6. 50-1,500 cycles, 22/6. Power trans. 25/-. Filter Choke 8 Hy 30 mA. 15/-. B. M. Kelly, 33 Froggat St., Turner, Canberra City.

SELL: University Oscillator Model OK1, £8. Bendix MN.26.C compass receiver, 32 volt operation, £20. W. Schulz, "Ventcher," Hughenden, Qld.

SELL: Philips No. 4 Comm. Revr. Switch bands 1.2 to 20. Mcs.—6 or 240 volt, £30 or best offer. K. A. Harding, 42 Spring St., Lismore, NSW.

SELL or EXCHANGE: Amplifier, 10 watt, crossover network with 2 speakers, Rola 12-0 and 6H. 3 channels, 2 mike 1 P.U. For good enlarger. P. Bessell, 132 Doncaster Av., Kensington.

SELL: B.R.S. Dual Speed Recorder, new. In case, £45. Lower Flat, 36 Park Av., Burwood.

SELLING OUT: 5 valve dual-wave Radiogram, 12" speaker, Collaro changer, mounted in drop front doored cabinet, side tidy for 80 records. Absolutely new for cost £50 or offer. KT 61's, EF 50's, etc. Stromberg Changer, OP 57 speaker trans, other parts, including 5 valve portable kit at wholesale or offer. J. Philipson, 66 Nicholson St., Fitzroy. N6., Victoria.

OFF THE RECORD

(Continued from Page 105)

orchestras recording at the present time.

On this point, Mr. Clarke was in entire agreement. He is confident that when the listening panel at Hayes in England hears these tapes, they will receive a pleasant surprise.

The processing of the discs will not be done in Australia. Although one copy is held here for reference, this work will be done at Hayes in England, and the world distribution of the recordings made from there.

More than ever I am convinced of the importance of this entire venture. It is a landmark in our musical life, and may well be the commencement of a whole series of recordings that will show the world what we can do, and open up wider fields for our music and musicians.

YOUR CAMERA

(Continued from Page 97)

the scale is correctly located with reference to the pointer, a hole should be punched through each of the mounting hole marks and the paper scale fastened to the metal one with small nuts and bolts. Final alignment can be checked by holding the assembly up to the light.

When this has been correctly adjusted, the upper half of the two scales are cemented together and left under moderate pressure until quite dry. Now the nuts and bolts may be removed, the remaining portions cemented and, when this is dry, the surplus paper may be trimmed off. This is best done by placing the scale face down on a piece of glass and trimming around the edge of the metal portion with a sharp razor blade.

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